Dual

721

August 1976 Edition

Service Manual

Dual Gebrüder Steidinger · 7742 St. Georgen/Schwarzwald

Specification

Current Type
AC 50 - 60 Hz, without motor changeover

Line voltages
110 – 130 Volt, 220 – 240 Volt

Drive
Electronically-controlled direct drive system Dual EDS 1000-2

Power Consumption
approx. 2.5 Watt
Motor during play $<$ 50 mW

Current Consumption

with 220 V 50 Hz:		
on start-up 60 mA	during play	20 mA
with 110 V 60 Hz:		
on start-up 110 mA	during play app.	38 mA

Run-up Time (until nominal speed is reached)
2 – 2.5 sec. on 33 1/3 rpm

Platter
Non-magnetic, dynamically-balanced, detachable, 1.5 kg
305 mm ϕ
Total rotating mass of drive system (rotor with platter)
3.0 kg, moment of inertia 250 kp cm^2

Platter Speeds
33 1/3 and 45 rpm, electronically switchable, automatic tonearm lowering coupled to speed change.

Pitch Control
Separate for both speeds, adjustable in each case with variable resistor, with setting scales, range of adjustment 10 %.

Speed Check
with light stroboscope for platter speed 33 1/3 rpm.

Sensitivity of Light Stroboscope for 0.1 % Speed Deviation
3 graduations per minute at 50 Hz
3.6 graduations per minute at 60 Hz

Overall Speed Variation
(assessed in accordance with DIN 45 507) $<$ ± 0.03 %

Signal-to-Noise Ratio (in accordance with DIN 45 500)

Rumble unweighted signal-to-noise ratio	$>$ 50 dB
Rumble weighted signal-to-noise ratio	$>$ 70 dB

Tonearm
Torsion resistant, extra long tubular aluminum tonearm in super flat universal four-point gimbal suspension, tonearm balance weight with double acting vibration damping (2 anti-resonators).

Effective Tonearm Lenght
222 mm

Offset Angle
25° 20'

Tangential Track Error Angle
0.16° / cm

Tonearm Bearing Friction
(related to stylus point)
Vertical $<$ 0.07 mN (0.007 g)
Horizontal $<$ 0.15 mN (0.015 g)

Tracking Force
0 - 30 mN (0 - 3 grams) infinitely variable with 1 mN (0.1 g) calibrations from 0 to 15 mN (0 to 1.5 g), operable from 2.5 mN (0.25 g) stylus pressure up.
0 - 3 g continuously variable, with 1/10 calibration in the range from 0 - 1.5 g, reliable as from 0.25 g tracking force

Pick-up Head
Detachable, suitable for all pick-up cartridges with 1/2" mounting and a deadweight of 2 - 10 g (including mounting material)

Adjustable Overhang
5 mm

Pick-up Cartridge
See separate data sheet

Weight
7.8 kg

Dimensions and Cutout Required
refer to Installation Instructions.

Fig. 1 Circuit diagram

EDS 1000-2

Dual

Strommeßbrücke
Current measuring bridge
Pont de mesure de courant

Leerlaufstrom ca. 55 mA
Idle current
Courant à vide

Anlaufstrom 255 mA ± 10 mA
Initial current
Courant de démarrage

−27 V
−14 V
0,7 V
20 V~

T 1 BD 135
T 2 BC 252 B
T 3 BC 338
T 4 BC 338
T 5 BC 338
T 6 BC 338
T 7 BC 338
T 8 BF 245 C
T 9 BC 172 B

D 1-D 4 1 N 4001
D 5 ZD 36
D 6 1 N 4001
D 7 ZPD 15
D 8 ZPD 7,5
D 9 AA 143
D 10 AA 143
D 11 AA 143'
D 12 AA 143
D 13 1 N 4148
D 51 BY 183 300

C 1 22 n
C 2 22 n
C 3 470 µ
C 4 50 µ
C 5 1,5 µ
C 6 0,15 µ ± 10 %
C 7 1 µ ± 10 %
C 8 47 µ +50 % - 10 %
C 9 10 µ ± 10 %
C 51 0,068 µ
C 52 0,047 µ

R 1 10 k
R 2 1 k
R 4 470
R 5 130
R 6 270
R 8 100
R 9 100
R 10 100
R 11 100
R 12 100
R 13 500
R 14 330
R 15 100
R 16 68
R 17 100
R 18 220
R 19 2 k
R 20 910
R 21 2,2 k (45 Upm)
R 22 100 k (33 1/3 Upm)
R 23 2,2
R 24 510
R 25 220
R 26 2,2 k
R 27 2,2 k
R 27 10 k
R 28 1 M
R 29 22 k
R 30 820 k
R 31 1 M
R 32 33 k
R 33 1 k
R 51 22 k
R 52 2,7 k

J 001 741

Gl. 1

T 0,125 A

45 Upm
33 1/3 Upm

Drehzahlschalter
Platter speed switch
Commutateur de vitesse

110 V
220 V
110/130 V
220/240 V
50 – 60 Hz.
10 n

Änderungen vorbehalten
Alterations reserved
Sous réserve de modifications

Von der Bestückungsseite gesehen
As seen from the top side
Vu du côté elements

Transistoren von der Anschlußseite gesehen
Transistors as seen from the connecting side
Transistors vus du côté des connexions

BC 172 B
BC 252 B
BC 338

BF 245 C

BD 135

Spannungen gemessen mit Meßinstrument (7 – 10 MOhm Eingangswiderstand) gegen Masse
Voltages measured with measuring instrument (7 – 10 MOhm input resistance) to ground
Tensions mesurées avec instrument de mesure (7 – 10 MOhm résistance d'entrée) contre masse

Ausgabe 1/März 1976

R			2		1			6	22,5			9	10		12		23	16,24		25	26			28	29		27				
					51		52		4		27	8			11		14,13	15		17	18		33	30,21			20	19	31	32
C	1		2		3		4												5			9	7,6							
					51			52														8								

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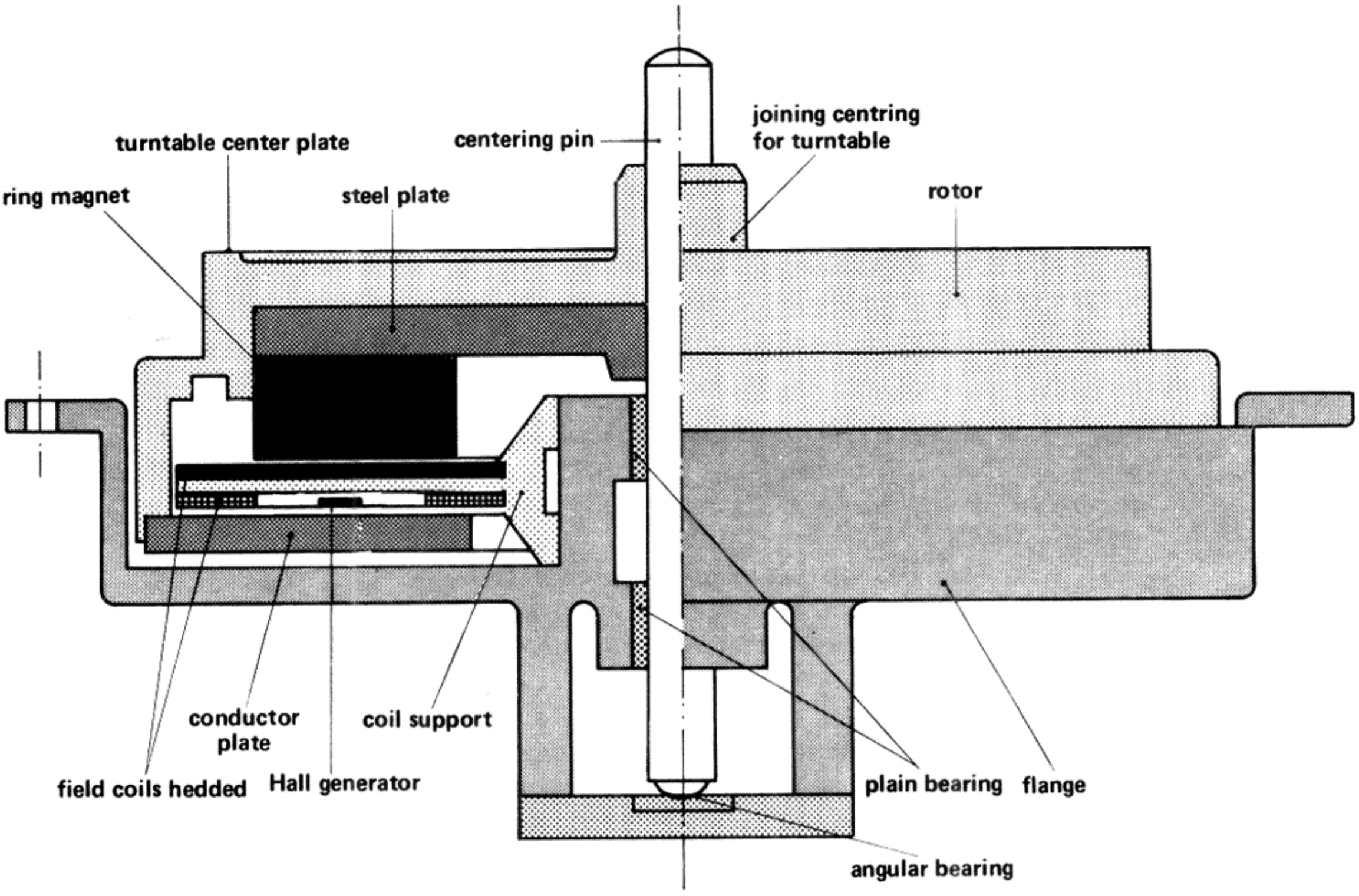
Note: The reference numbers in the instructions refer to the spare parts lists and exploded views.

Fig. 2 Dual EDS 1000-2 Electronic Direct Drive System



Dual EDS 1000-2 Electronic Direct Drive System

The EDS 1000-2 motor especially designed for the Dual 721 is a slow-running no-commutator DC electronic motor which draws its power supply from a stabilized power pack.

The electro-mechanical commutation normally carried out on DC motors by the commutator is electronically controlled in the case of the Dual EDS 1000-2 motor by two Hall generators. These two Hall generators - dependent on the rotor position - control four switching transistors which in turn have the effect of a rotating magnetic field occurring in the field coils of the motor by means of which the four pairs of magnets of the rotor are continuously attracted or repelled. By means of the torque thus exerted, uniform rotation is induced in the rotor - and with it the platter.

A speed-dependent voltage (tacho voltage) induced in the motor windings not switched on is coupled out and controls the electronic regulator circuit. This ensures that even the slightest deviations from the nominal speed are corrected in fractions of a second by a change in the motor current. Speed fluctuations are, therefore, practically eliminated.

Absolute maintenance of the nominal speed no longer presents any problem with this control system.

The above-mentioned Hall generator is a magnetically controllable semi-conductor element named after the physicist E. Hall. With the Hall effect as a result of the action of a magnetic field on the Hall generator a voltage approximately proportionate to the strength of the magnetic field is generated, its polarity being dependent on the direction of the magnetic flux.

A control current flows through the Hall generator. If now a magnetic field becomes effective at right angles to the area of the Hall generator, the so-called Hall voltage occurs. With constant control current this Hall voltage is dependent on the direction and strength of the magnetic field. If the polarity of the magnetic field is reversed, the polarity of the Hall voltage changes as well. In the absence of a magnetic field the Hall voltage is zero. This effect is utilized to control the Dual EDS 1000-2 motor.

As the motor is operated on DC from a stabilized power pack it operated independently of line voltage and frequency fluctuations.

The motor is of 8-pole disk rotor design. The rotor has a barium ferrite annular magnet inside which has 8-pole magnetization on its lower face.

A slotless steel disk connected to the rotor acts as magnetic return.

The field windings of the motor are ironless and are embedded in a plastic support. The field windings consist of 16 double wound coils which are arranged in two planes above one another. The 8 coils of the lower plane are 22.5° offset in relation to the top plane. In each plane there is a Hall generator in the center of one coil. The two Hall generators are also offset by 22.5° in relation to one another.

The individual windings - 32 in all - are connected together so that four all round phase windings are produced.

Compared with other directly-driven record players in the case of the Dual EDS 1000 motor no form of magnetic drag or restoring force is present (pole jerk etc.) as can easily be detected by turning the rotor. As a result of the ironless field coils no hysteresis or eddy current losses or interfering slot-ripple frequencies occur.

This results in completely vibration-free motor running together with a low power consumption of less than 50 mW during play (the electronic system is not taken into account). By virtue of this vibration-free running the motor can be rigidly connected to the chassis. The electronic system itself is divided into the switch, commutation and control sections (see block diagram).

Fig. 3 Line Board (Equipment Side)

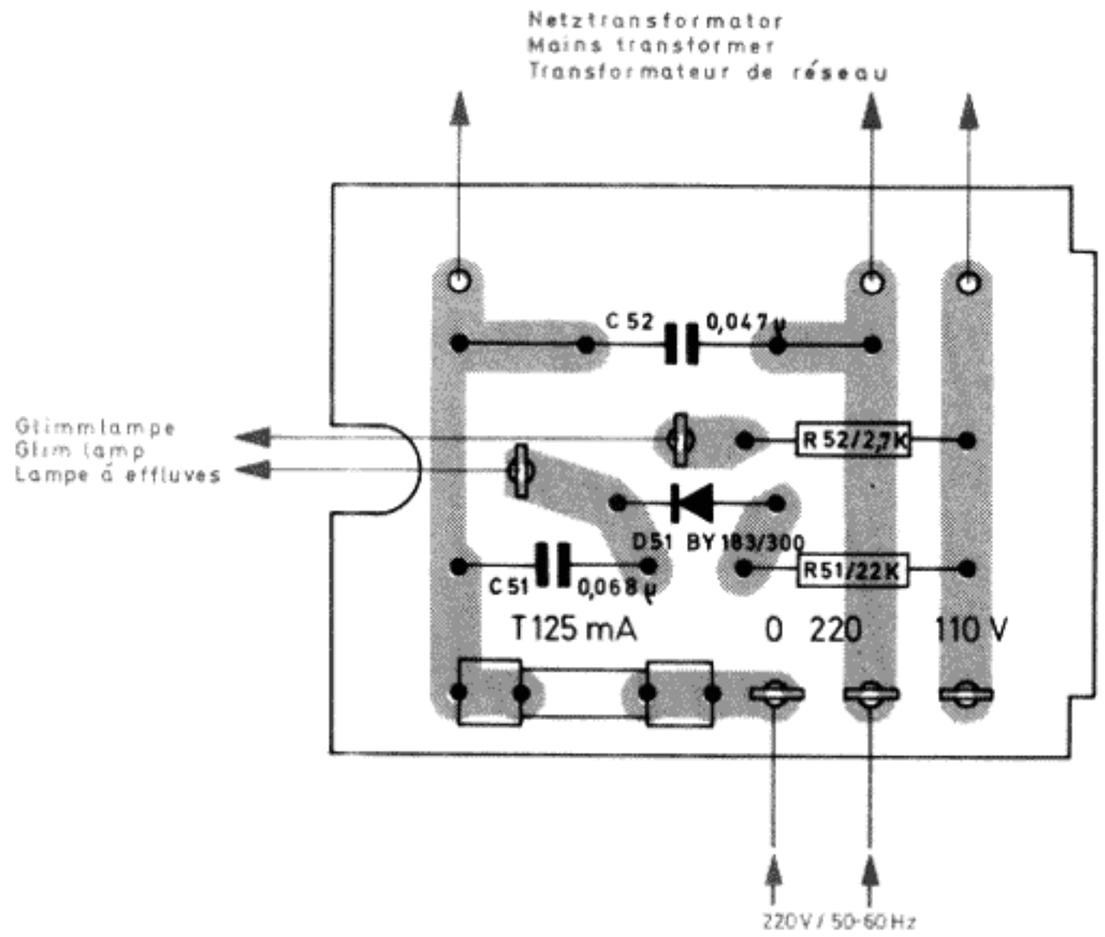
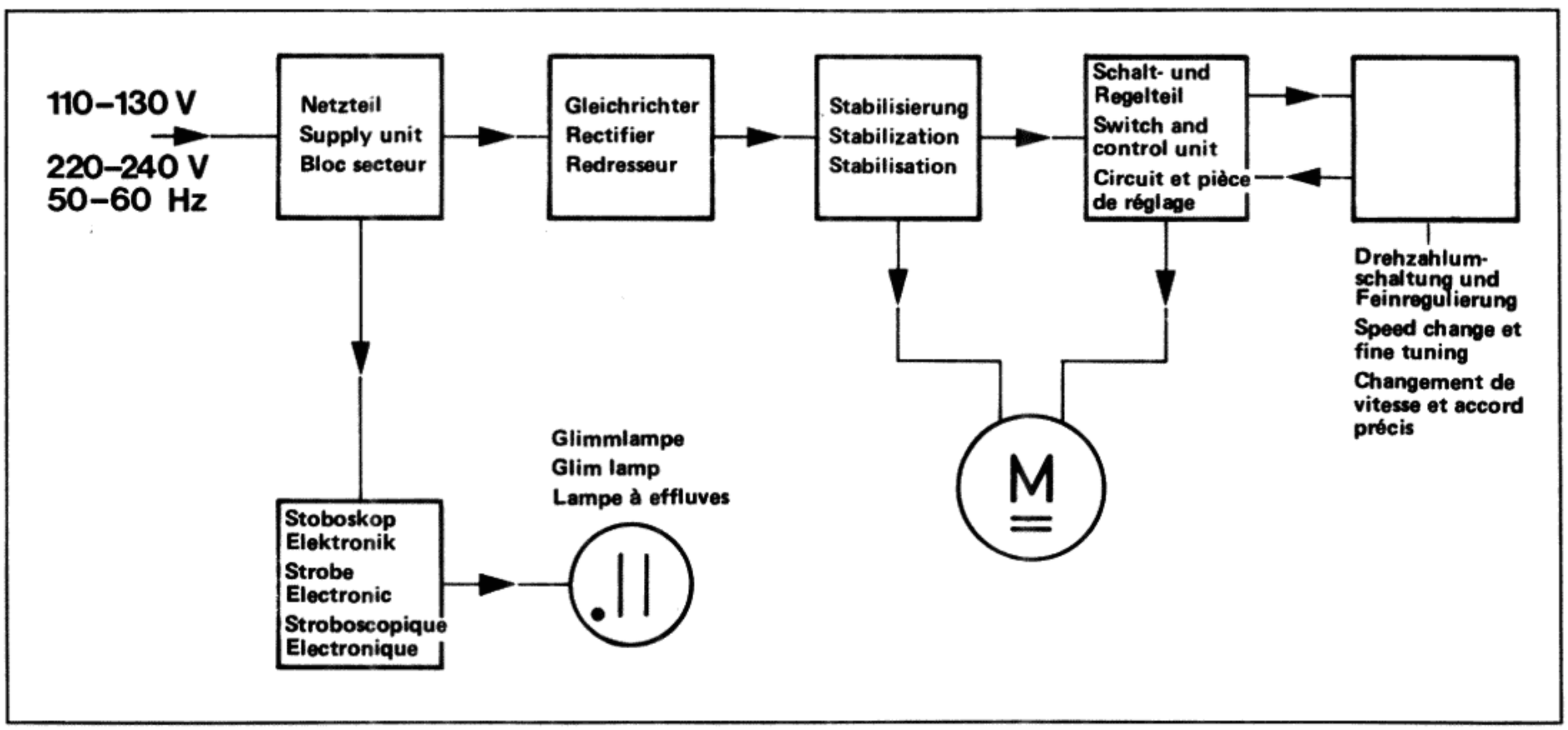


Fig. 4 Block Diagram



Description of Function

The 4 phase windings are each in the collector circuit of the 4 switching transistors T 4 to T 7 (Fig. 5) and are connected together in star form at one point. This point is connected to the minus pole of the supply voltage.

The position of the rotor illustrated in Fig. 6 has the effect that the magnetic field of the south pole of a pair of poles at connection 11 of the Hall generator H 1 gives rise to a Hall voltage maximum of negative polarity.

Transistor T 4 whose base is joined to connection 11 of the Hall generator therefore receives a negative base emitter voltage and is fully connected through whereby the current flows through the phase winding W 1 located in the collector section or it is switched on.

Transistor T 5 whose base is joined to connection 9 of Hall transistor H 1 is blocked by the positive Hall voltage potential.

As Hall generator H 2 is in the neutral zone of the pair of magnetic poles during this period, no Hall voltages occur at its connections 7 and 5. The transistors T 6 and T 7 joined to these connections are, therefore, blocked as well.

The switched on phase winding W 1 (Fig. 7 a) produces clockwise rotation of the rotor through 22 1/2°. This cycle takes place, displaced electrically in each case by 90°, in sequence in all four phase windings.

Fig. 5

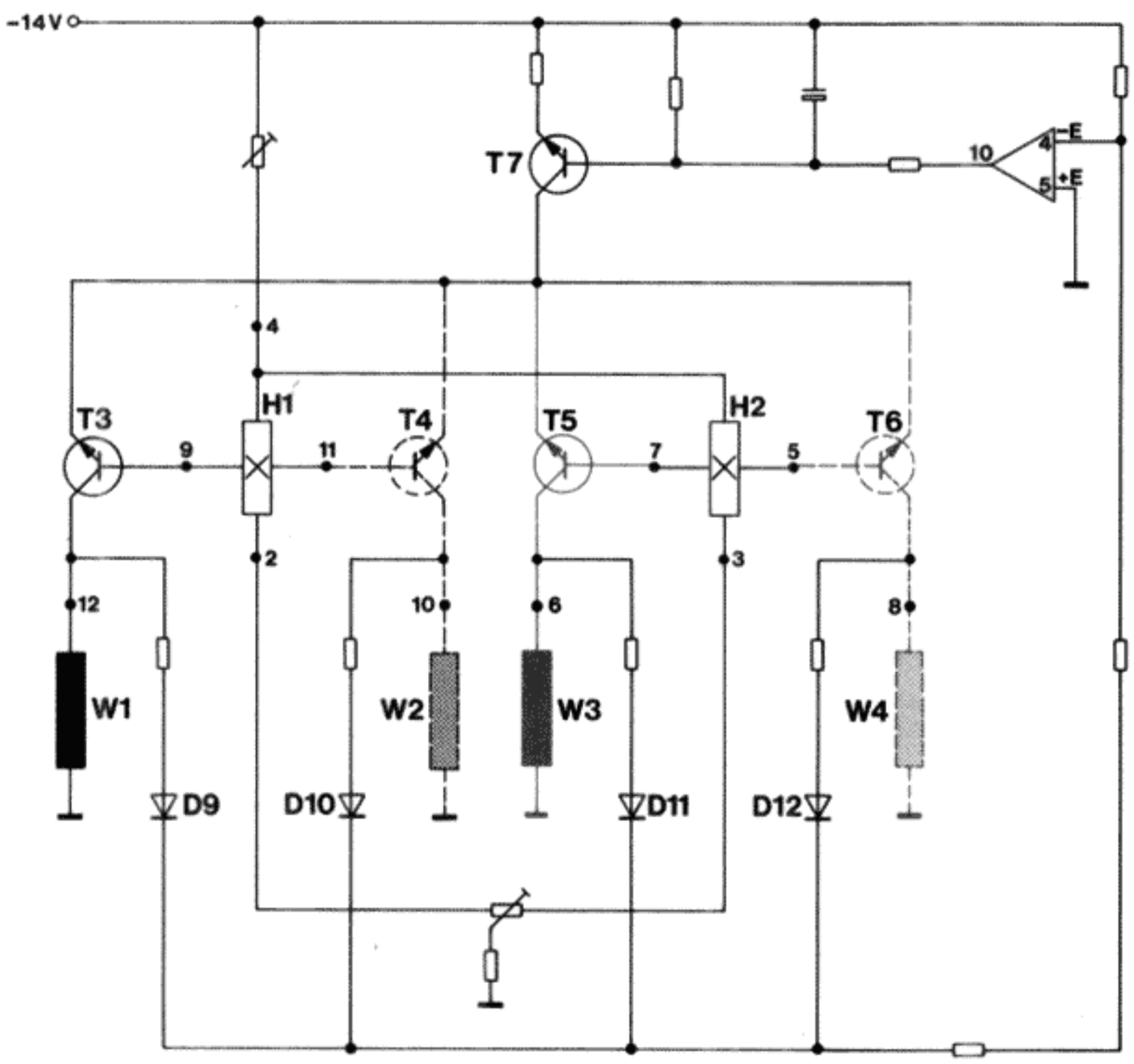
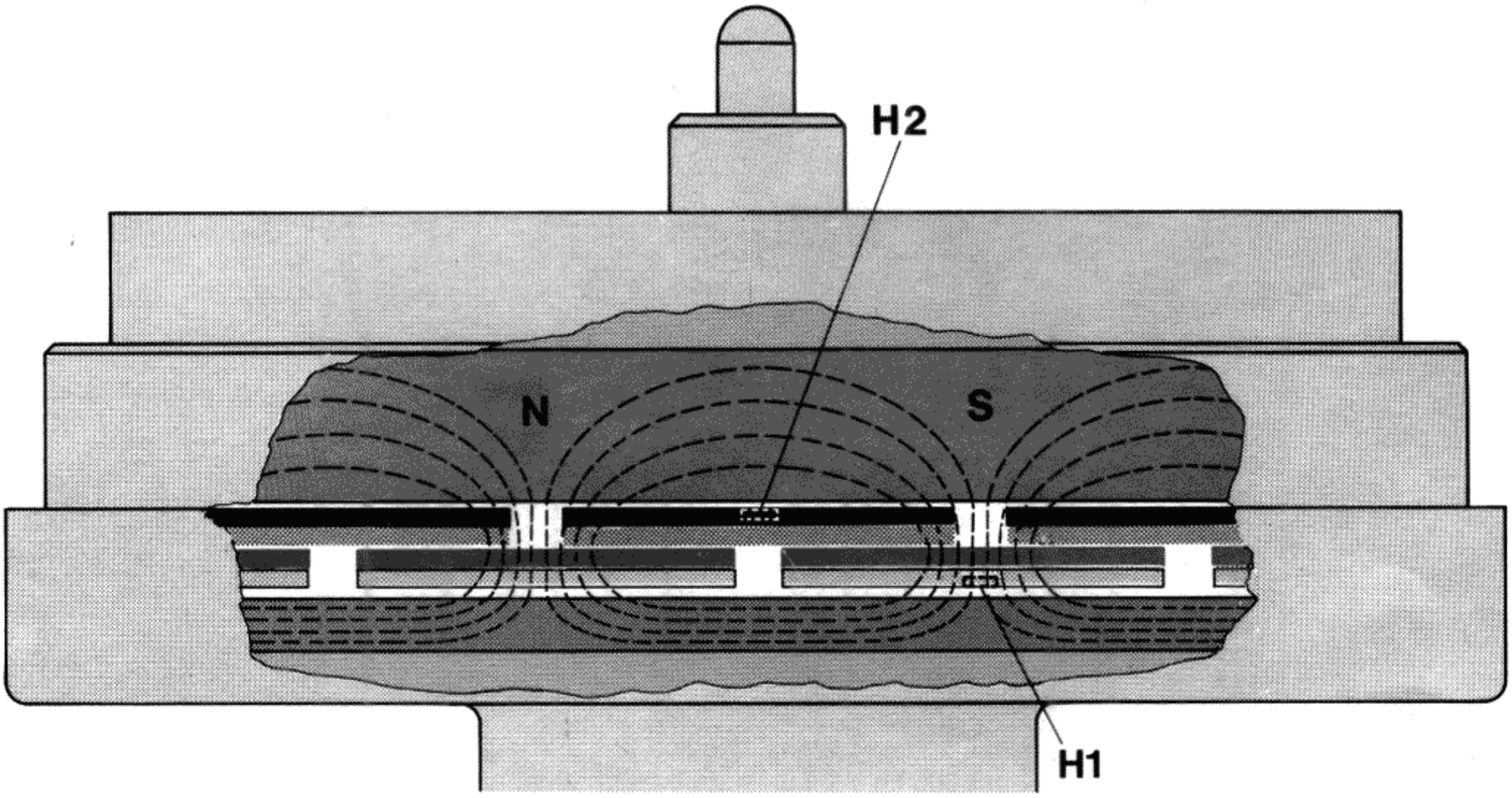


Fig. 6



Thus the following sequence of movement takes place:

After the 1. rotation phase (Fig. 7 b) the Hall generator H 1 is located in the neutral zone of a pair of magnetic poles. One south pole is now directly above Hall generator H 2 and now also produces at its connection 7 a Hall voltage maximum of negative polarity which switches on phase winding W 3 via transistor T 6. All other transistors are blocked. The rotor now rotates again through 22 1/2° through the magnetic fields generated in phase winding W 3.

After elapse of the second rotation phase (Fig. 7 c) the Hall generator H 2 is now in the neutral zone of a pair of magnetic poles. Hall generator H 1 is now directly underneath a north pole and a Hall voltage of reversed polarity occurs, i. e. the negative polarity Hall voltage maximum is now present at connection 9 which connects through phase winding W 2 via transistor T 5.

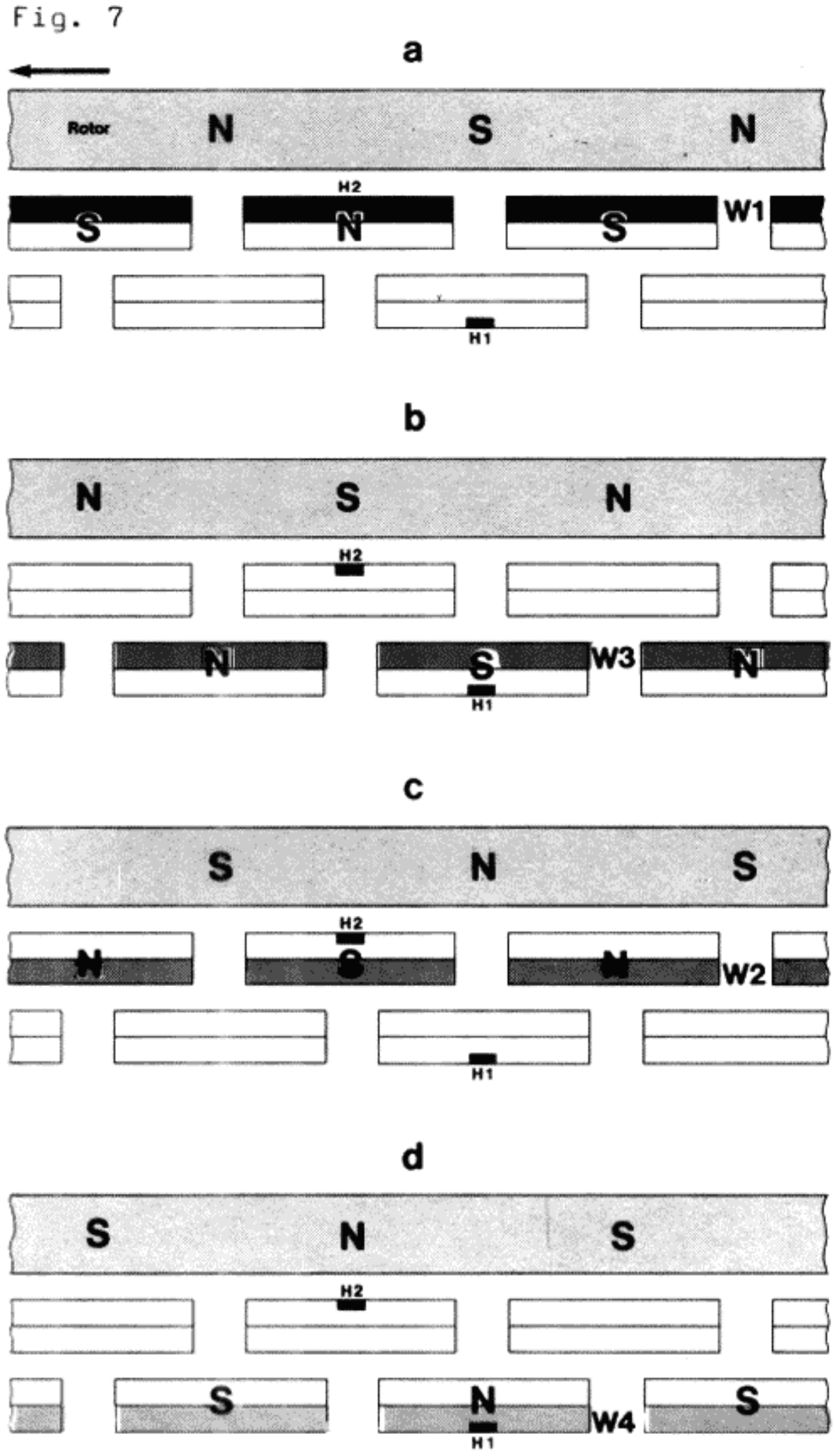
The other transistors are blocked. The rotor again advances by 22 1/2°.

After this 3. rotation phase (Fig. 7 d) Hall generator H 1 is in the neutral zone. A north pole is above Hall generator H 2 and produces a negative Hall voltage at its connection 5 which switches on phase winding W 4 via transistor T 7. The rotor advances by a further 22 1/2°.

After conclusion of this 4. rotation phase the process starts again. Thus, a continuous rotating field occurs which drives the rotor at an uniform rate.

If the rotor is, for example, between two phase windings, a partial flux of a pair of magnetic poles passes through both Hall generators and thus two switching transistors are partly opened. The current is divided accordingly between two phase windings. Both phase windings participate simultaneously in the torque formation and together produce the torque of a fully-connected phase winding. The torque is, therefore, almost constant in any position of the rotor.

Fig. 7



Speed Regulation

As a result of the rotary movement of the rotor, voltages are induced in the phase windings not connected through which are coupled out via diodes D 9 to D 12. Thus, a tacho voltage proportionate to the speed is obtained.

The tacho voltage passes via a voltage divider to connection 4 of the operation amplifier in the control section and counteracts the voltage present there. A stabilized voltage is present at connection 5 of the operation amplifier.

On start-up and during run-up of the motor the potential at connection 4 of the operation amplifier is more or less positive in relation to connection 5. In this condition the operation amplifier fully drives transistor T 7. T 7 is present as variable resistance in the common emitter circuit of the four switching transistors through which practically the full switching current can flow in sequence.

The nominal or controlled speed is reached when the same potential is present at connection 4 of the operation amplifier as at connection 5, because at this moment the operation amplifier closes transistor T 7. As a result the motor current drops and the speed cannot, therefore, increase any further.

By switching over or altering the voltage divider in the control circuit the controlled speed can be preselected or altered. With reducing speed the potential at connection 4 of the operation amplifier would change so that transistor T 7 would be fully driven. T 7 would thus become of low resistance, the result would be a sharp rise in the motor current and thus of the speed.

As this control process takes place even at minor deviations from the nominal speed, a constant speed independent of load fluctuations is obtained.

For repair of the Dual EDS 1000-2 special tools and measuring means are required. Work on the motor or motor electronic system should, therefore, only be carried out by an authorized Dual service station. Expenses arising from unauthorized interference will be charged to the consignor.

Removal

Lift off platter (4). Remove housing of power pack (123) after removing screws (117).

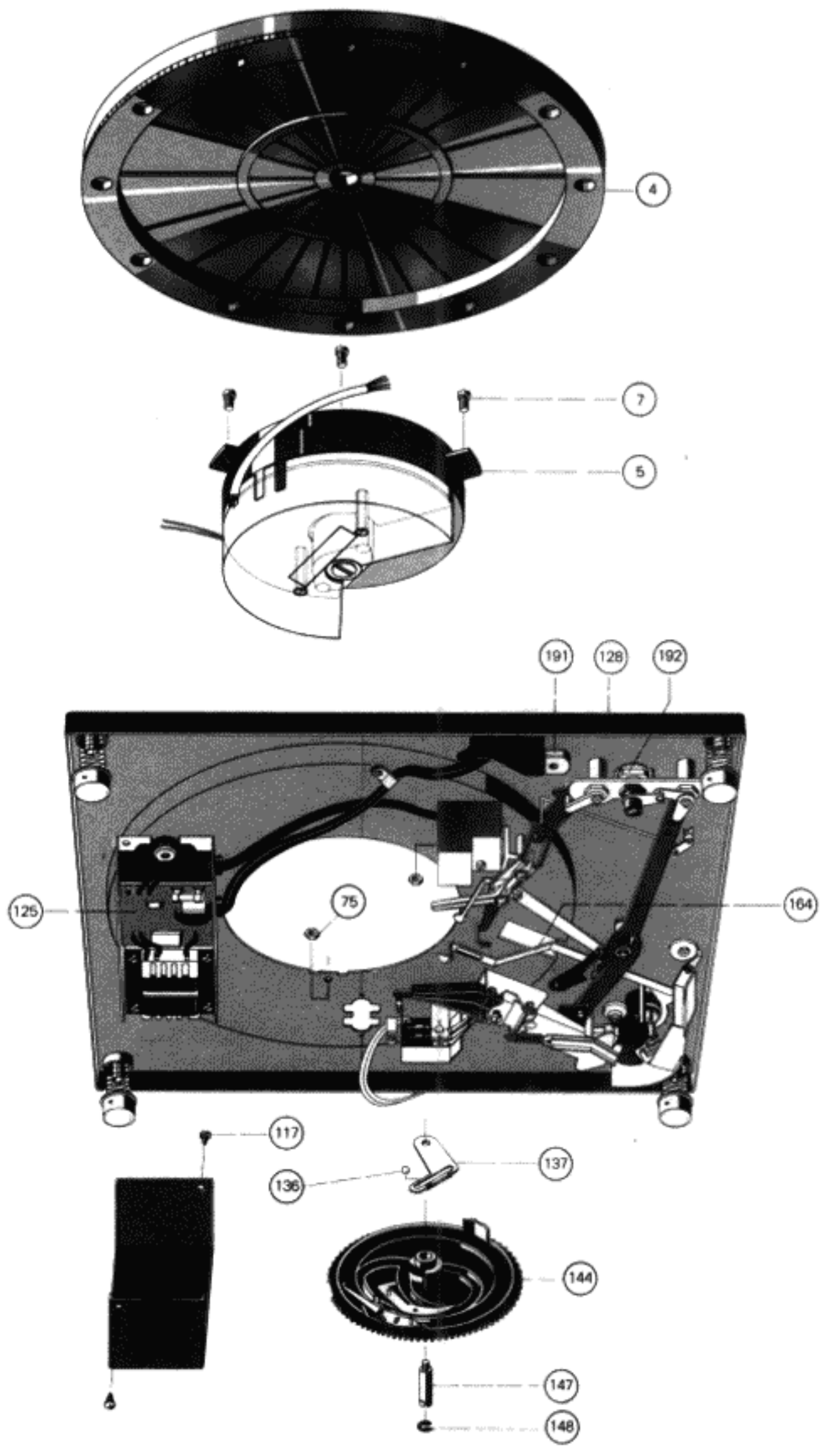
Attention! Unsolder leads for operating voltage on power board (125). Do not remove cable on motor side.

Unsolder connections on rotary knob (192) and potentiometer (191/R 33). Pull off insulating tube.

Unscrew complete bearing pillar (147) and remove together with washer (148). Remove cam wheel (144). Be careful with ball (136) in stop bar (164). Remove intermediate plate (137).

Undo hex nuts (75) and the three machine screws. Lift motor (5) and make sure that the connecting leads and the thermistor are routed in the chassis recessed. Remove the motor. Slide the insulating tube over the connecting leads. Place motor in original carton for return shipment.

Fig. 8



Installation

Remove motor from packing, pull off insulating tube. When inserting the motor on the mounting board (21) ensure that the lead outlet hole faces the power pack (123).

Now, refit motor and other disassembled parts in reverse order to that described under "Removal".

Attention: To prevent deformation of the shorting springs the camwheel (144) should not be fitted in 0 position. Make sure that the pin of main lever (154) is engaged in the guideway of the camwheel (144).

After assembly fit knob (44) complete with pin in midposition. Switch on unit and check current consumption on operation.

220 V/50 Hz approx. 18 mA
117 V/60 Hz approx. 35 mA

Using control (R 21) set nominal speed 45 rpm (check by means of a strobe disk), using control (R 22) set nominal speed 33 1/3 rpm. Run in for approximately 5 minutes and, if necessary, correct speed.

Note: It is advisable subsequently to carry out a brief check of all unit functions.

Stroboscope

Accurate setting of the platter speeds 33 1/3 and 45 rpm can be checked during play with the aid of the stroboscope.

When the platter (3) is rotating at exactly 33 1/3 or 45 rpm the lines of the stroboscope appear to stand still. If the lines move in the direction of rotation of the platter, the platter speed is too high. If the lines move backwards, the platter is rotating more slowly than the nominal speed.

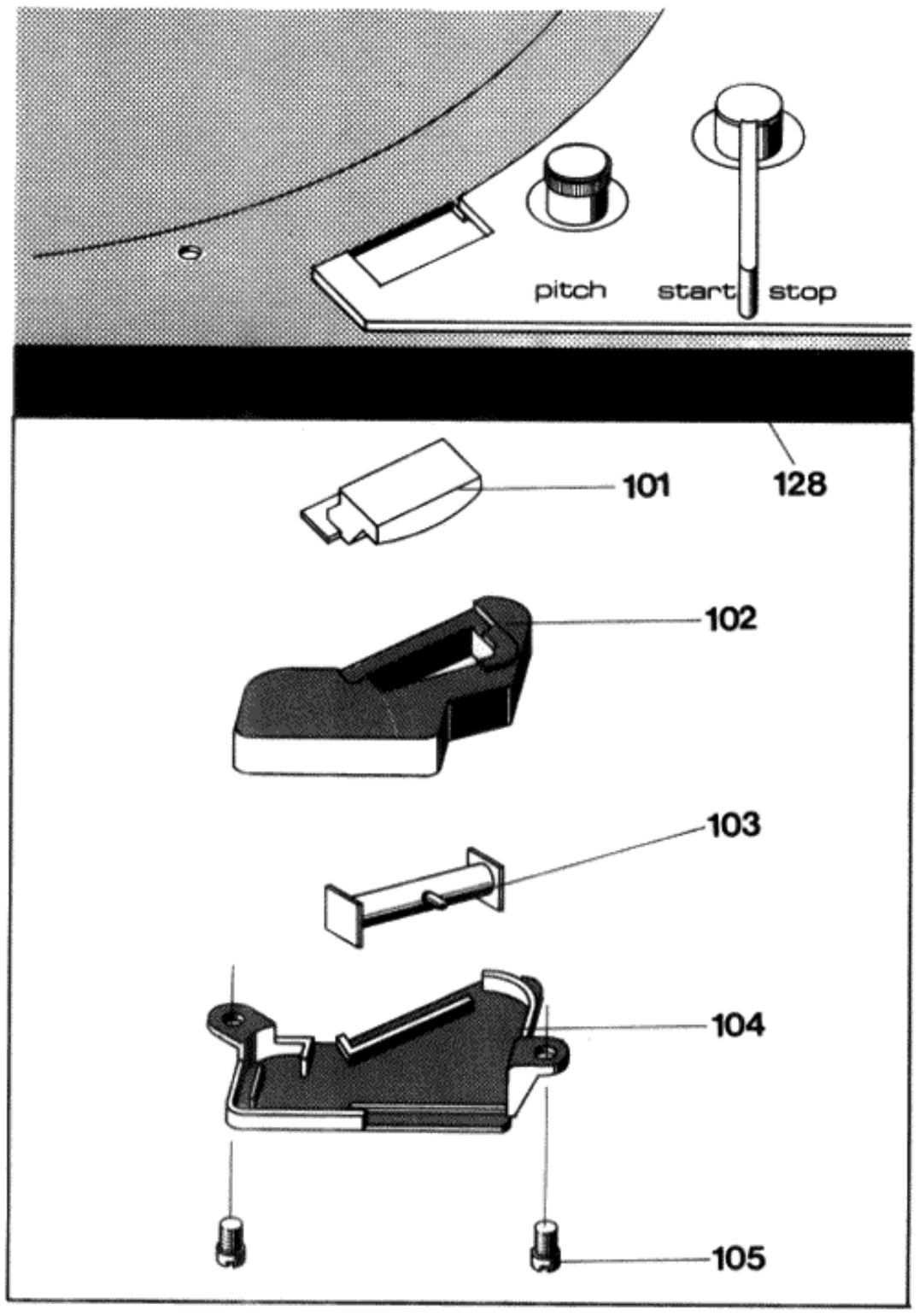
Adjustment of platter speeds 33 1/3 and 45 rpm is carried out separately with the "pitch" knobs (44).

It can happen that the stroboscope lines appear to move slightly although the exact speed setting with stroboscope lines stationary has not been altered. This apparent contradiction is explained by the fact that the electronic central drive motor operates fully independently of line frequency whilst the only relatively accurate line frequency of the AC current supply is used for speed measurement with the light stroboscope. The constantly detectable fluctuations of line frequency by ± 2 % (according to the information of the electricity supply companies) brief frequency fluctuations up to 1 % are possible - only effect the stroboscope indication and can cause the lines to "wander" although the platter speed is as constant and absolutely accurate as before.

Strobe markings are provided on the outer edge of the platter for 50 and 60 Hz line frequencies.

To replace glow lamp (103) remove machine screws (105) and remove strobe cover (104).

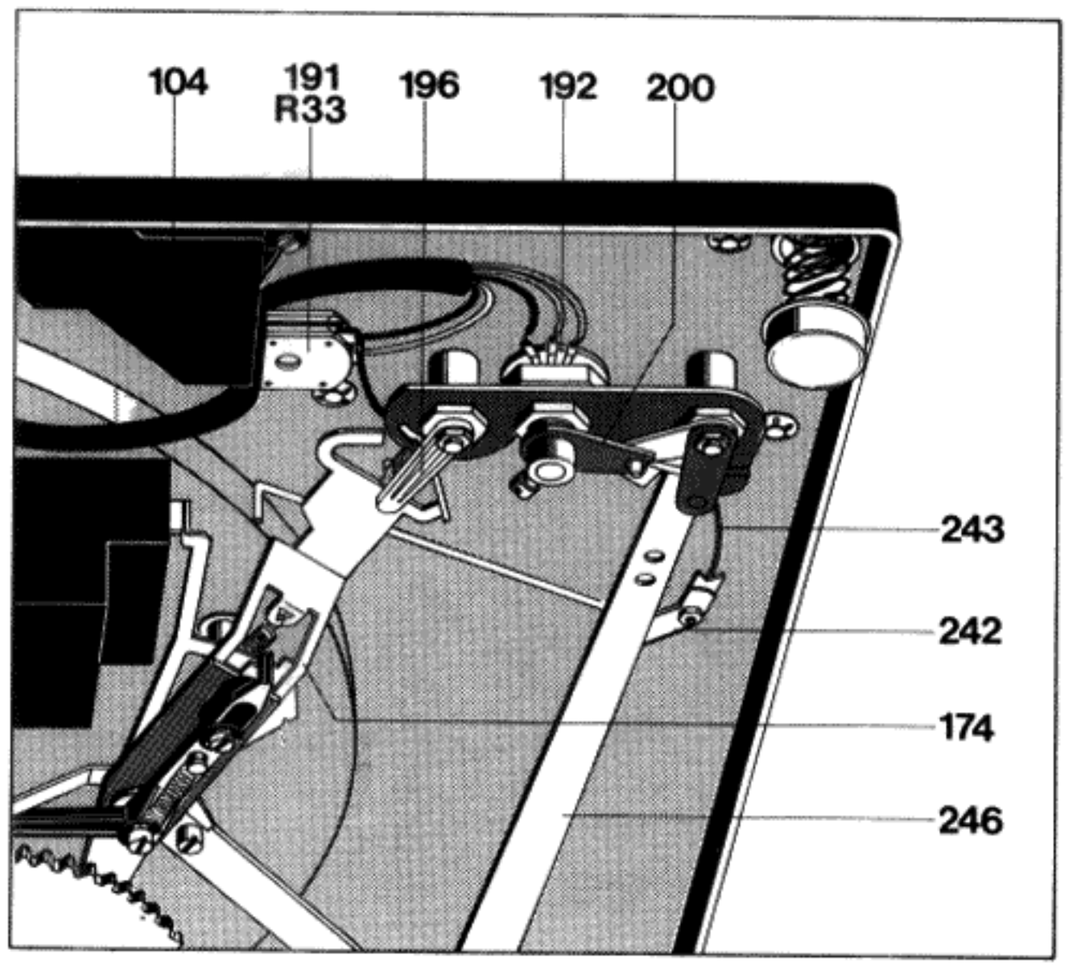
Fig. 9 Stroboscop



Pitch Control

Each of the two standard speeds 33 1/3 and 45 rpm can be varied by approximately 10 %. The variable speed control (R 33) located in the voltage divider is adjusted by turning the pitch control knob (44). By this means the operation amplifier is altered and the motor speed accordingly.

Fig. 10 Pitch control

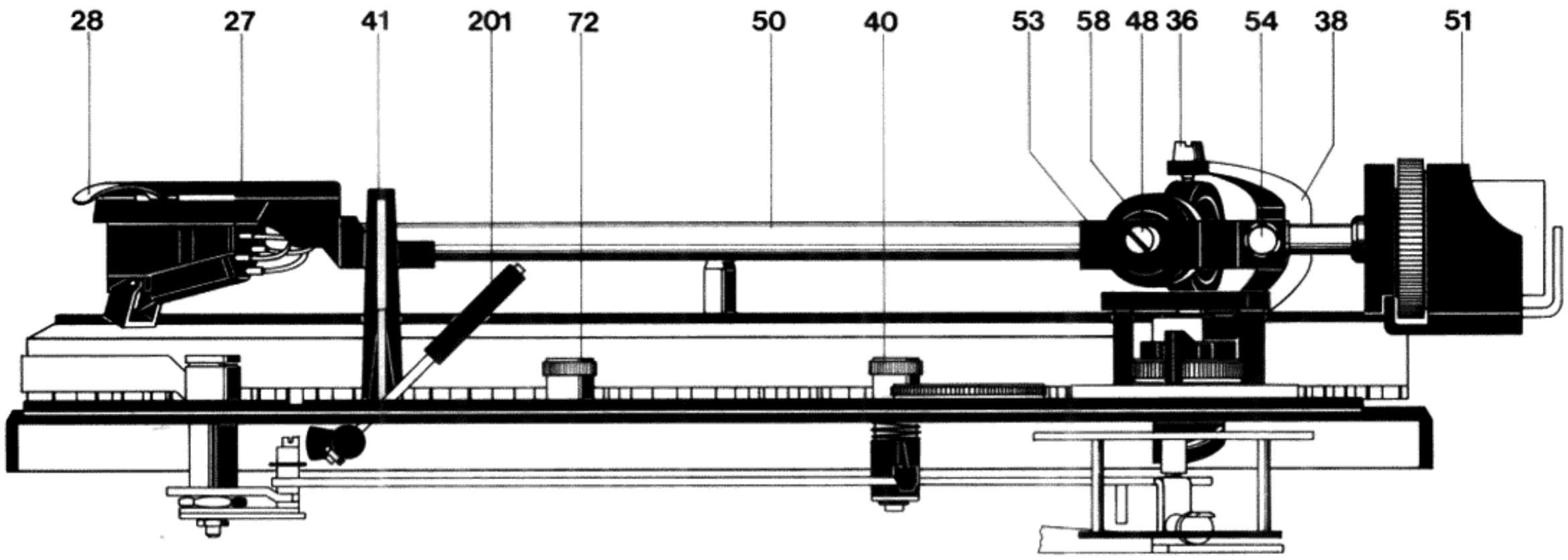


Adjusting the nominal speed

Using knob (44) bring the variable speed control (191) into midposition.

Nominal speed 33 1/3 rpm using R 22 control
Nominal speed 45 rpm using R 21 control
Check with strobe disk.

Fig. 11 Tonearm suspension



Tonearm and Tonearm Suspension

The feather-light,extremely torsion resistant all-metal tonearm is suspended in a gimbal. Suspension is by means of 4 hardened and precision polished steel points which rest in precision ball bearings. Tonearm bearing friction is thus reduced to a minimum.

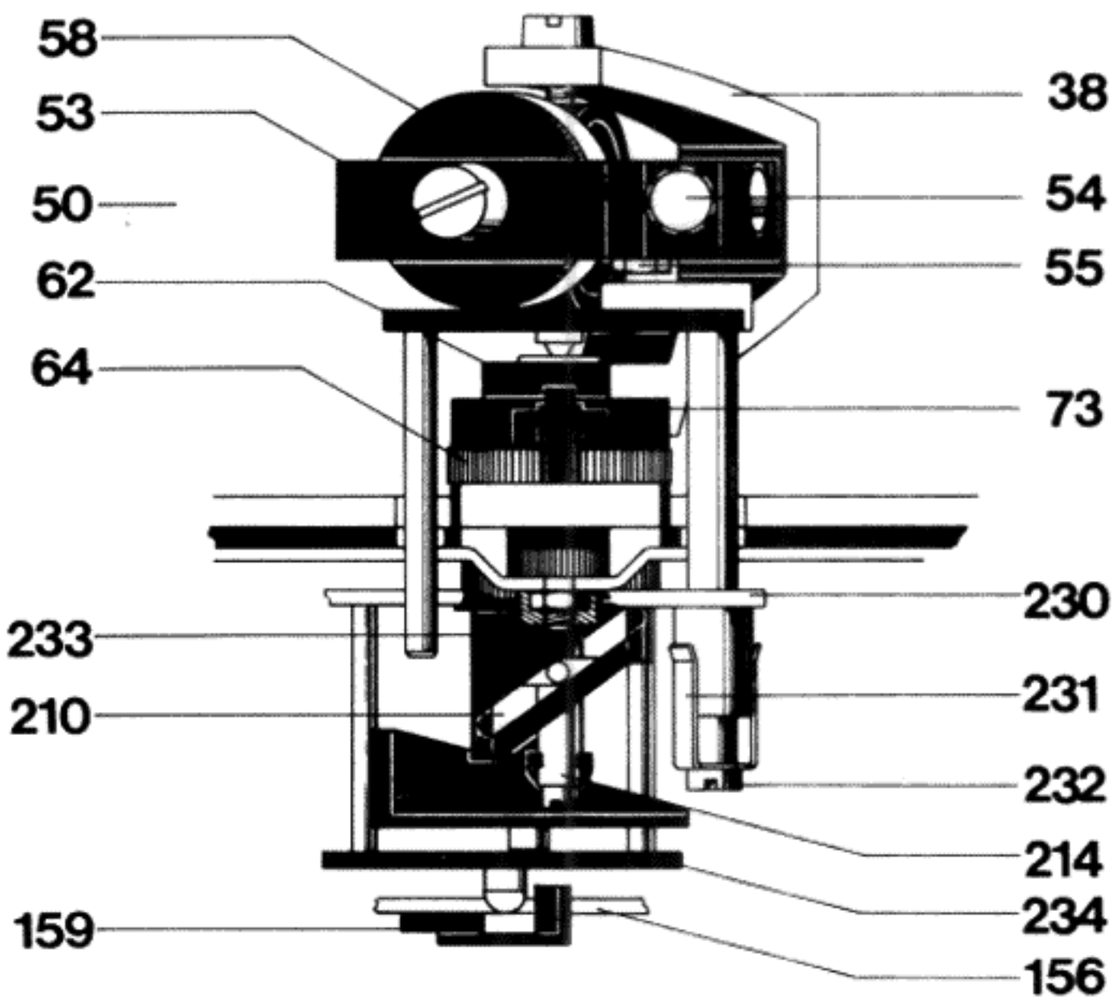
Bearing friction vertical ≦ 0.007 p
Bearing friction horizontal ≦ 0.015 p
as related to stylus point

As a result, it ensures most favourable pick-up conditions. Before adjusting the pick-up force to suit the built-in pick-up cartridge the tonearm is balanced with the scale set to zero. Coarse adjustment is carried out by moving the weight with the stem (51), the subsequent fine adjustment by turning the weight.

The balance weight is designed so that pick-up cartridges having a deadweight of 4.5 - 10 g can be balanced. It takes the form of a double anti-resonator thus absorbing the vibration energy in the range of tonearm and chassis resonance. For this purpose, the inner part weight is matched to the tonearm resonance and thus acts as anti-resonator by means of antiphase vibration. The outer part of the balance weight taking the form of a higher balanced anti-resonator prevents transmission of partially occurring chassis resonance to the tonearm.

The tracking force is adjusted by turning the graduated spring housing (58) incorporating a coil spring. The scale has markings for a range of adjustment from 0 to 30 mN (0 to 3 p) which permit accurate adjustment of the tracking force. One graduation in the range of 2 - 15 mN (0.2 - 1.5 p) corresponds to 1 mN (0.1 p), in the range of 15 - 30 mN (1.5 - 3 p) to 2.5 mN (0.25 p).

Fig. 12



Removal of tonearm (50) from bearing frame

1. Secure unit in repair jig. Remove weight (51) unscrew fixing screw (54). Set tracking force scale to zero.
2. Move unit into head position. Remove screening plate (133). Unsolder tonearm on muting switch (131).
3. Move unit into normal position. Turn both mounting screws - SW 4.5 - (55) counterclockwise to the stop of the bearing frame (53).

Attention! Observe the bayonet mounting. Slide tonearm (50) rearwards and remove it upwards from the bearing frame.

For installation proceed in the reverse order.

Removal of tonearm assembly with tonearm bearing

Proceed as follows:

1. Secure unit in repair jig. Set graduated spring housing (58) to zero. Arrest tonearm (50). Remove weight (51).
2. Loosen tension lever (62) and bring tonearm (50) in its highest position using knob (64). Fasten tension lever (62). Bring knurled ring (66) in position "3".
3. Turn unit upside down. Remove screening plate (133). Unsolder tonearm leads on the muting switch.
4. Remove machine screw (217), hex nut (218) and fillister head screw (70). Also remove transition plate (268) and guard plate (219).

5. Unscrew machine screw (232) and holding spring (231).
6. Hold tonearm (50) and unscrew pin (214). Unlock tonearm (50) and remove it carefully.

When installing the tonearm complete with suspension, proceed in reverse order considering the following points:

Place pressure spring (39) on axle of frame (38). Both axles of bearing (56) should align segment (230) accurately. Frame (38) should not contact cover (73) after tightening bolt (214). Mount holding spring so that it does not contact the setting plate when moving the tonearm (50).

Replacing spring housing (58)

Remove tonearm (50) from bearing frame (53) as described above. Loosen lock nut (48) and threaded pin (49). Unscrew bearing screw (60). Lift bearing frame (53). Remove spring housing (58) and washer (59). When installing note that the helical spring catches the bearing frame. Slide in washer (59) and tighten bearing screw (60). Reinstall tonearm (50). Set bearing play as described below using threaded pin (49) and lock nut (48).

Adjusting the Tonearm Bearing

First balance tonearm exactly. Both bearings must have slight, just perceptible play. The horizontal tonearm bearing is correctly adjusted when at anti-skating settings "0.5" and being touched it slides in without resistance. The vertical tonearm bearing is correctly adjusted when it swings in after being touches. The play of the horizontal tonearm bearing should be adjusted with threaded pin (37), the play of the vertical tonearm bearing with threaded pin (49).

Vertical Tonearm Control

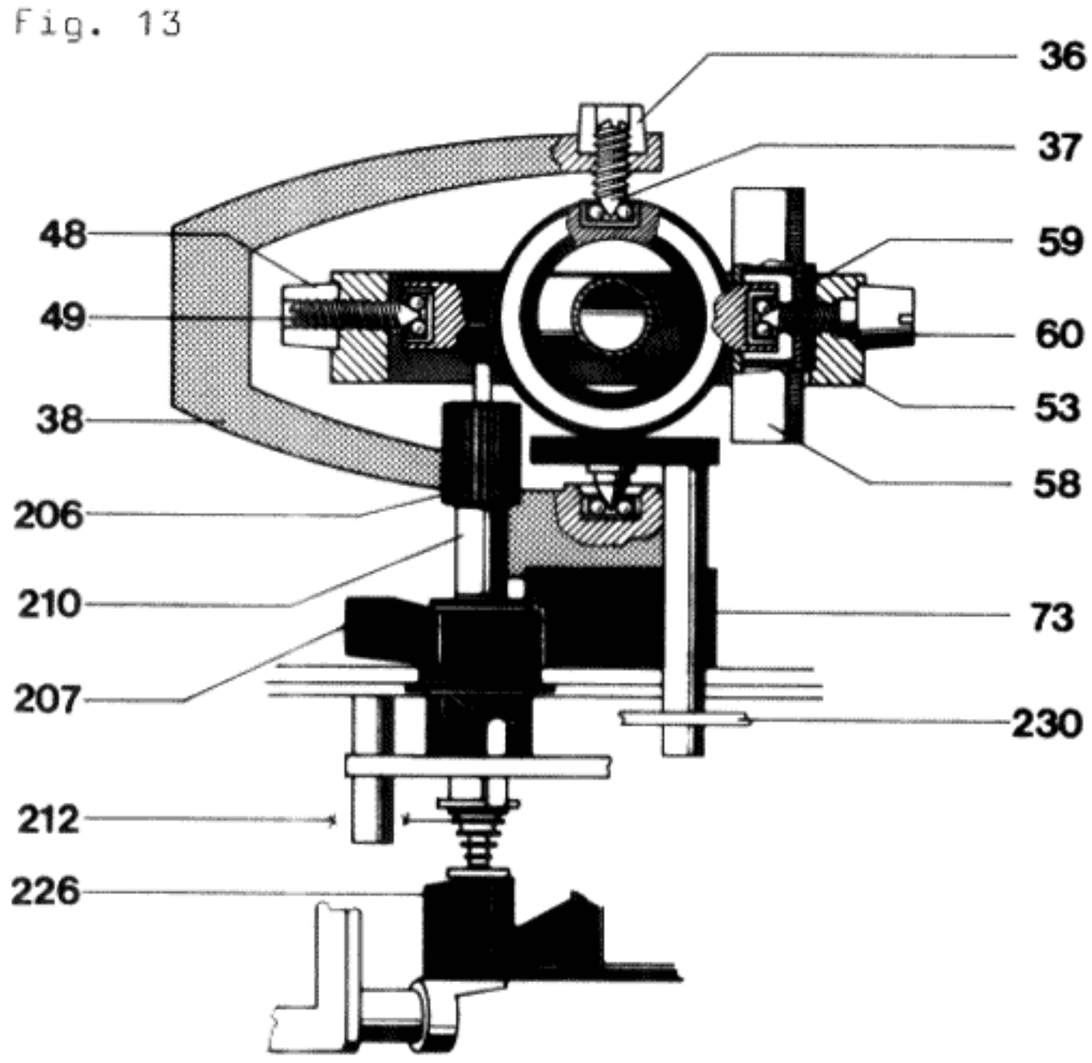
After loosening the tension lever (62) the tonearm can be shifted vertically within the range of approximately 8 mm by turning knob (64). When turning knob (64) the pivot cam (223) is moved thus shifting the cue control assembly (210) and the tonearm bearing (38) vertically. This device is used to maintain the vertical tracking angle of the pick-up cartridge independent from its height (distance between the mounting level of the cartridge and stylus tip). The vertical tracking angle is properly adjusted - with the stylus tip on the record - when the tonearm is exactly paralleled to it. To check for correct adjustment proceed as follows:

Disconnect unit plug from power line. Correctly balance tonearm and adjust tracking force. Put a 30 cm record on the platter. Now, lower the stylus on the run-out groove using the cue control.
Check setting, correct if necessary. Tighten tension lever (62) clockwise. Operate cue control (▼) and bring back tonearm manually on the rest. Lower cue control (▼). Connect unit plug to power line. For automatic adjustment of the mechanical gear and the shut-off mechanism the unit should be started for the first time with the tonearm locked.

Adjustment Point:

Knob (64) should not be movable when tension lever (62) is tightened. Adjustment can be made after loosening machine screw (229) and sliding or shifting adjustment plate (228).

Fig. 13



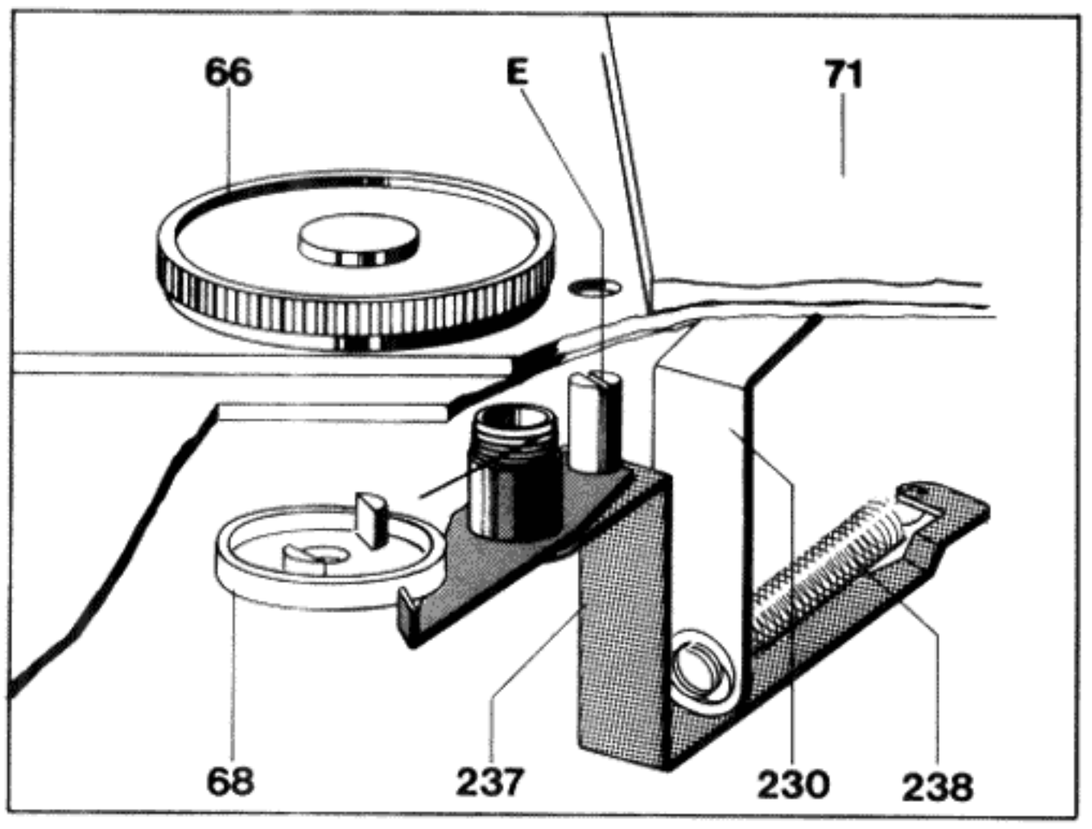
Anti-Skating Device

To compensate for skating force use the knurled ring (66). The asymmetric cam plate (68) displaces the skating lever (237) from the tonearm pivoting point. The anti-skating force is transmitted to the segment (230) and to the tonearm (50).

Optimum adjustment is carried out at the works for styli with a tip radius of 15 µ (conical), 5/6 and 18/22 µm (elliptical), and CD 4-cartridges.

Any alteration can only be carried out with the aid of a Dual-Skate-O-Meter and a test record and should only be done by an authorized service station.

Fig. 14 Anti-skating



Recheck as follows:

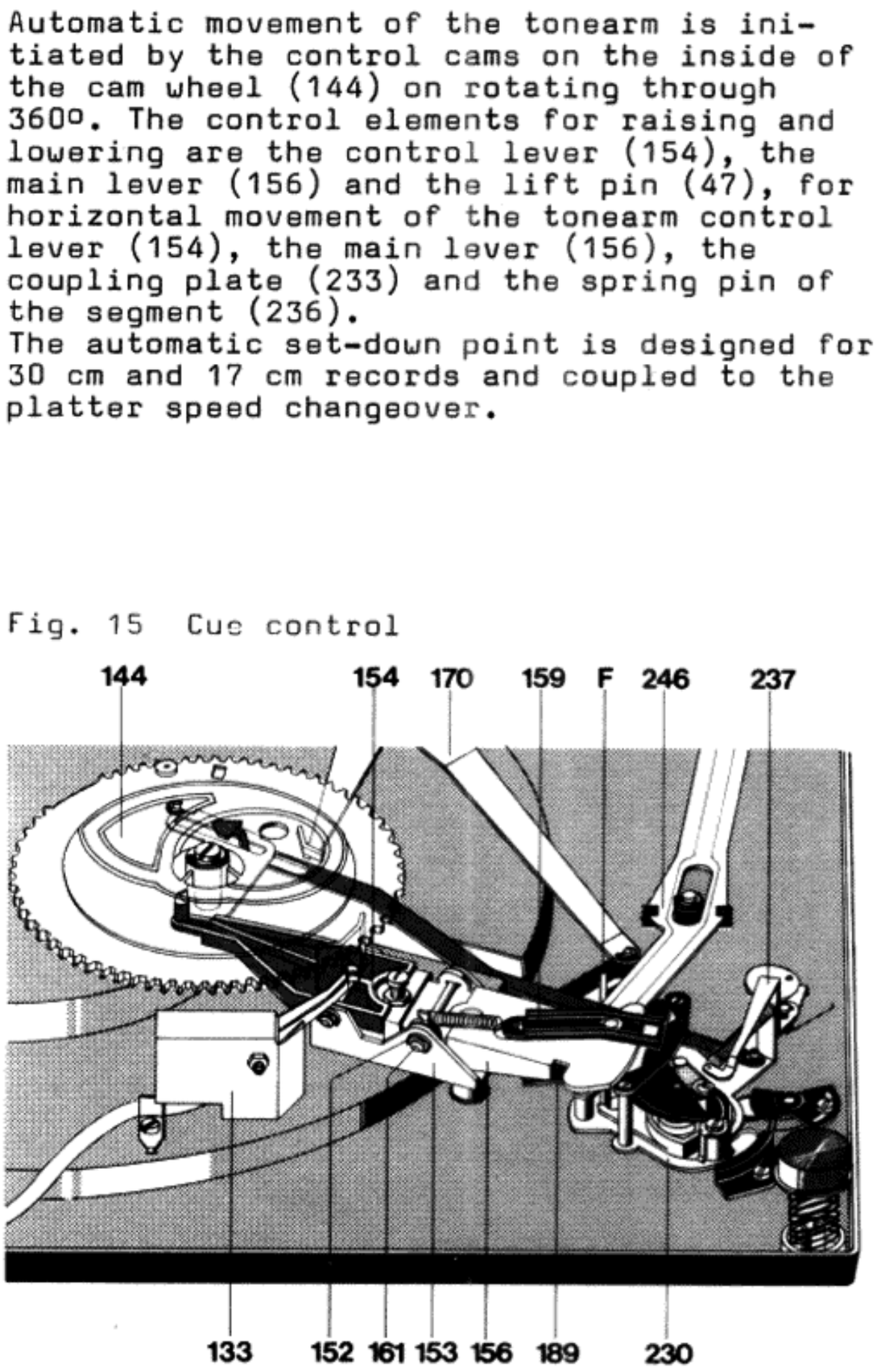
Balance tonearm (50) correctly. Set knurled ring to 0. The tonearm should remain at any desired point within its turning range. The hole of the skating lever (237) should be in alignment with the center line of the tonearm. Adjustment is made by the eccentric pulley (E) which is accessible through the hole in the installation plate (21) between the knurled ring (66) and the tonearm mounting plate (71). See Fig. 14.

The set knurled ring to "0.5". The tonearm should now smoothly rotate from the platter center to its rest.

Tonearm Control

Automatic movement of the tonearm is initiated by the control cams on the inside of the cam wheel (144) on rotating through 360°. The control elements for raising and lowering are the control lever (154), the main lever (156) and the lift pin (47), for horizontal movement of the tonearm control lever (154), the main lever (156), the coupling plate (233) and the spring pin of the segment (236).
The automatic set-down point is designed for 30 cm and 17 cm records and coupled to the platter speed changeover.

Fig. 15 Cue control



Limitation of the horizontal movement (set-down point) of the tonearm is produced by the pin of segment (230) contacting the stop (189) attached to the slide bar (246).

Only during set-down does main lever (156) lift the slide bar (246) and the stop (189) attached to it which, as a result, moves into the swivel range of the stop pin fitted on segment (230). On completion of set-down (lowering of the tonearm onto the record) slide bar (246) is released again and returns to its neutral position. As a result, stop (189) moves out of the swivel range of the stop pin (F) so that unimpeded movement of the tonearm is possible for playing.

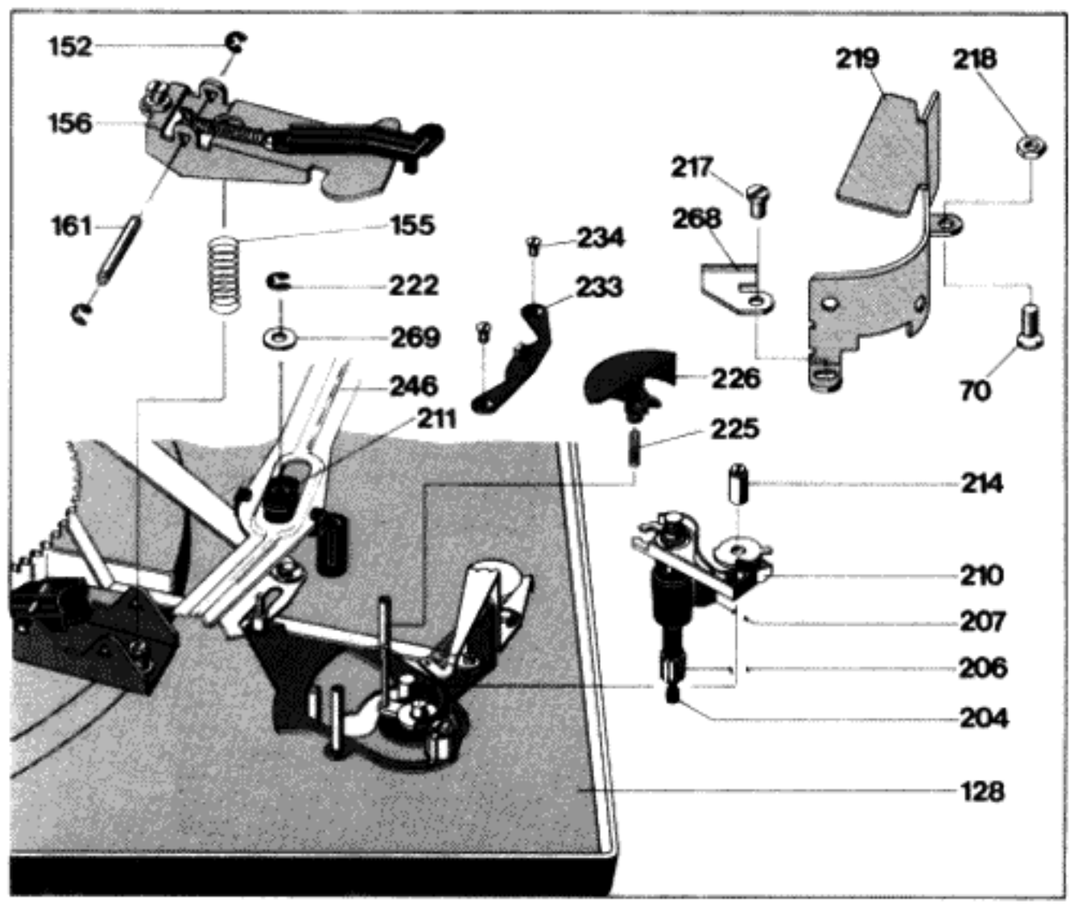
Cue Control

By moving the lever (201) forward (▼) lift cam (203) rotates. The slide bar (246) connected to it transmits this movement to the lift pin (213) (via the compensating cam) which then raises the tonearm.
As a result, the cue control permits set-down of the tonearm at any desired point.

The slide bar (246) is released by moving the cue control lever rearwards (▲). As a result of the action of compression spring (212) lift pin (213) is returned to neutral position and thus lowers the tonearm. Lowering of the tonearm is damped by silicone oil in the lift tube. The height of the stylus above the record can be varied by turning adjusting screw (44). Turning bush (207) to ">" reduces the lowering speed, turning the bush to ">>>" increases the lowering speed.

The distance between the record and the stylus can be varied by set screw (40). It should be approx. 3 to 5 mm.

Fig. 16 Replacement of Cue Control Plate



Replacement of Cue Control Plate

Replace cue control plate (210) as follows:

1. Fix unit on repair jig and lock tonearm. Remove weight (50). Turn unit upside down.
2. Loosen tension lever (62), bring tonearm in its lowest position using knob (64).
3. Set knurled ring (66) of the anti-skating device to position "3".
4. Remove machine screw (217), hex-nut (218) and fillister head screw (70). Remove transition plate (268) and guard plate (219).
5. Remove safety washer (152) and axle (161). Also remove main lever (156) and compression spring (155).
6. Remove countersunk screws (234) and coupling plate (233).
7. Loosen safety washer (222), then turn set screw (40) until slide bar is released. Place slide bar (246) complete with bearing (211) beside the bearing pin.

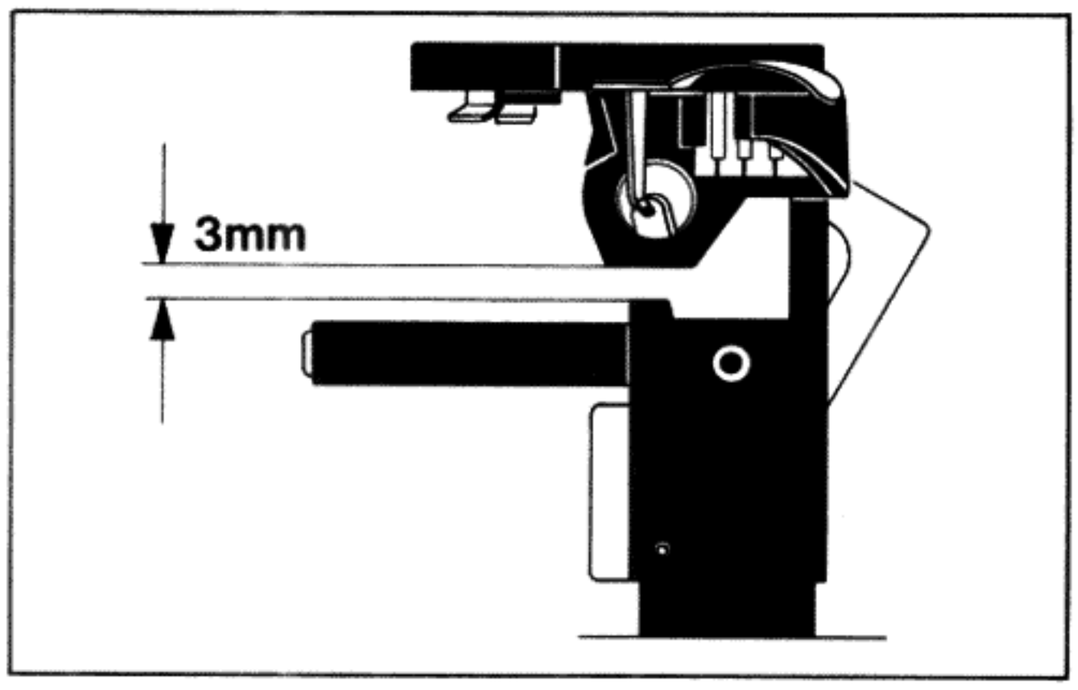
8. Remove compensating cam (226) and compression spring (225).
9. Undo pin (214). Turn bush (207) to " ". Remove cue control plate (210) from cam (223). The turn until the bush (207) fits the recess of the mounting plate (128) so that the cue control plate (210) can be removed.

For installation proceed in reverse order.

Adjustment points

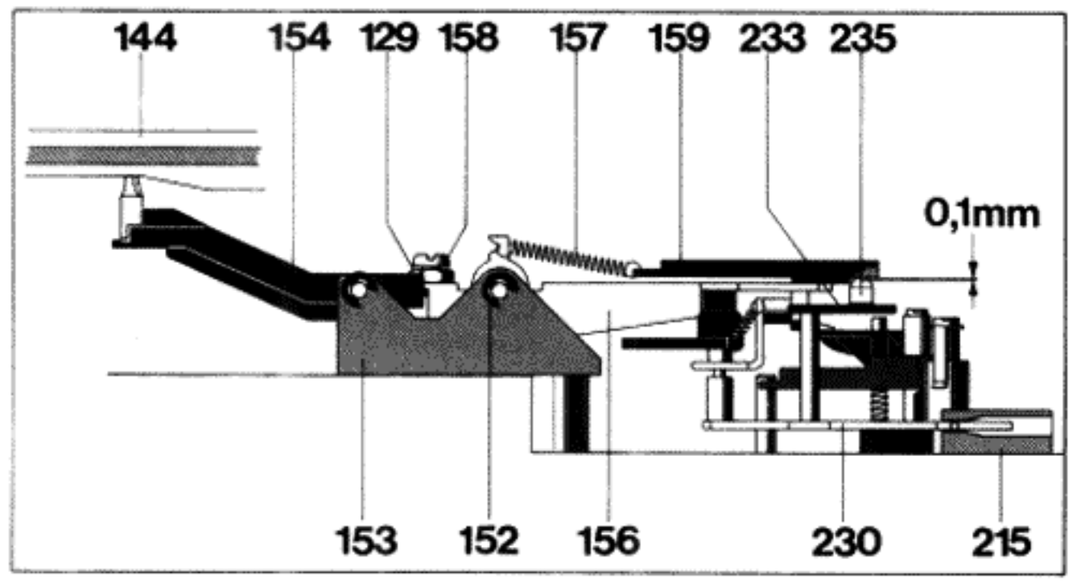
a) Disconnect unit plug from power line (mains). Move lever (74) to "start" position. Rotate platter (4) until the tonearm has reached its highest position. The distance between the lower edge of the pick-up head (27) and the rest (41) should be approximately 3 mm. Adjust by turning bush (206) (Fig. 17).

Fig. 17



b) Disconnect unit plug from power line. Lock tonearm (50). Move lever (74) to "start" position. Rotate platter (4) and observe shaft pin (235) of the coupling plate (233). The guide lever (235) on the main lever (156) should just touch the shaft pin or just move it by 0.1 mm (adjustable by setting machine screw (158) (Fig. 18).

Fig. 18



Starting

Change lever (174) is rotated when the left control lever is turned to "start". This results in the following function being initiated.

The control arm (170) connected to change lever (174) operates the power switch which starts the motor (5) rotating. Simultaneously, pawl coupled to the change lever (178) by a tension spring engages and retains it in this position.

The change lever (178) presses the shut-off lever (142) toward the dogs on the motor pinion and thus causes the camwheel (144) to rotate. The pawl then moves deflection lever (139) into starting position.

After fitment and each time after transport the unit should be started once with the tonearm locked for automatic adjustment of the mechanical gear.

Adjustment points:

a) Place unit upside down. Disconnect power line plug until detent (164) is secured. Slightly move cam (144) out of position. The play between the detent (164) and pin (B) should be about 0.3 mm (see Fig. 21). Correct setting by bending switch arm section (LS).

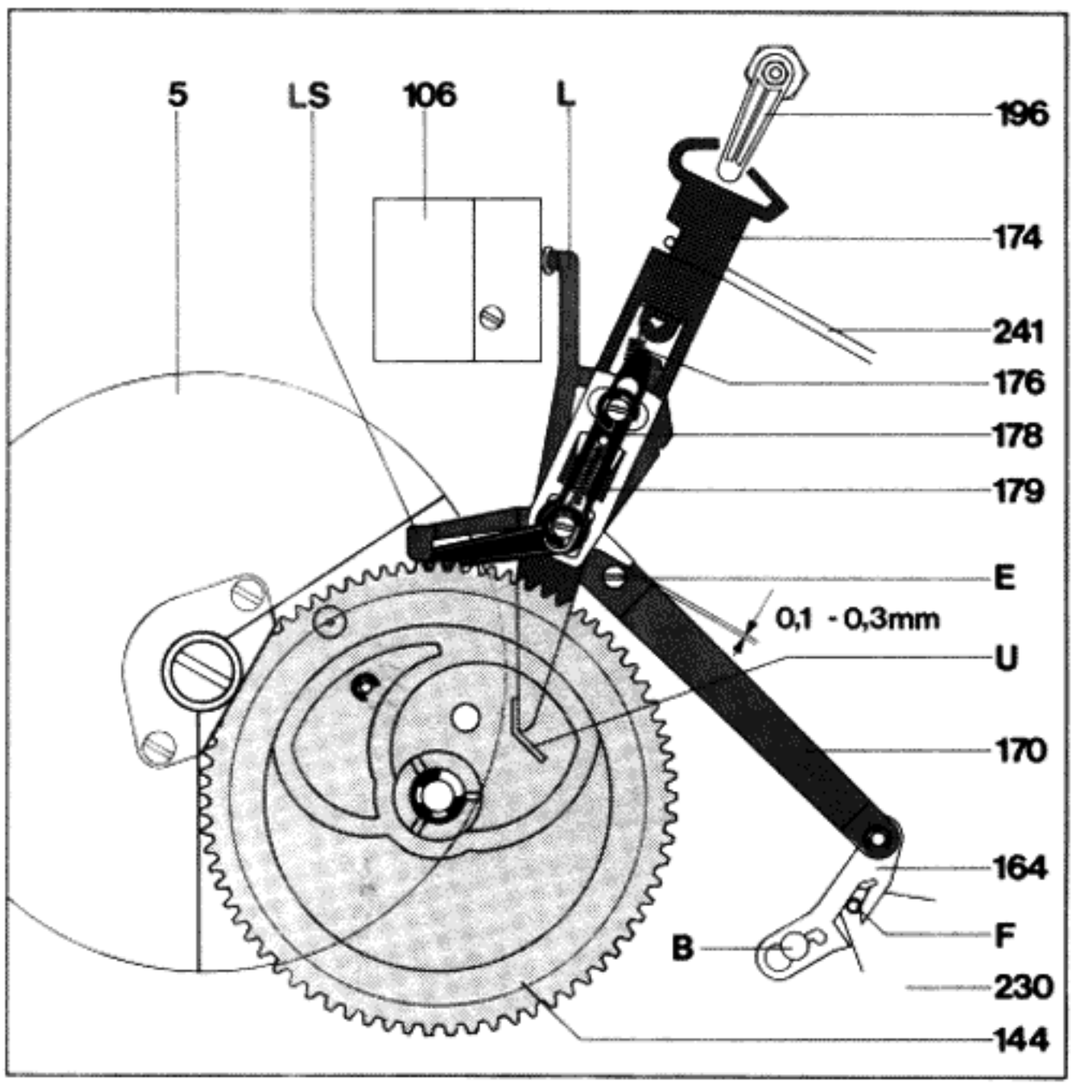
b) Disconnect unit plug from power line. Place unit upside down. Operate control lever (74). Rotate motor. The power switch (106) should operate shortly before the change lever (178) catches. Adjustment should be made by turning eccentric pulley "E".

c) Tonearm (50) should lower the stylus exactly on the lead-in groove. The adjustment screw is accessible through the hole between control lever (74) and the cue control. The adjustment screw should be either turned clockwise or counterclockwise.

d) The change lever (174) should bring deflection lever (139) into the start position.

Adjustment can be made by slight bending of change lever section (U).

Fig. 19 Starting



Manual Start

The detent (164) coupled to control arm (170) engages the pin in the chassis when the tonearm is moved inwards by hand and retains the tonearm in this position (Fig. 21).

The power switch is operated by the control arm and thus the platter starts to rotate.

After reaching the run out groove of the played record return of the tonearm and shut-off of the unit take place automatically. If, on the other, the tonearm is lifted off the record before playing is completed and is moved onto the rest by hand, the pin of the segment disengages the detent (164) so that the control arm is returned to its starting position. As a result, the power switch shuts off the power supply.

Adjustment point

Extract power plug. Turn unit upside down. Move tonearm inwards. Power switch should switch safely. Correct adjustment by bending control arm (L).

Stopping

When control lever (74) is set to "stop" position the change lever (174) is turned anti-clockwise. The deflection lever (139) remains in its stop position.

Muting switch

To prevent disturbing noises during automatic operation of the tonearm the unit is fitted with a muting switch. Control of the switch springs for both channels is effected by the camwheel. With the unit in neutral state the short circuit of the pick-up leads is eliminated.

Adjustment point

In neutral position the distance between contact springs should be about 0.3 mm. Correct by slightly bending contact springs.

Continuous automatic play

The continuous automatic play is operated by turning knob (72) to "∞". Switch bracked (242) is actuated by knob (72). Switch rod (241) keeps change lever (174) in start position. After playing the record the tonearm returns automatically to the lead-in groove of the record. The record will be played again. This procedure will be repeated until cancelled by pushing control lever (74) to "stop" or turning knob (72) to position "1".

Adjustment point:

Bring turning knob (72) to "∞" position. The play between the eccentric pulley (E) and change lever (174) should be 0.1 to 0.3 mm. Adjust by bending the switch rod (241) (Fig. 19).

Fig. 20 Muting Switch

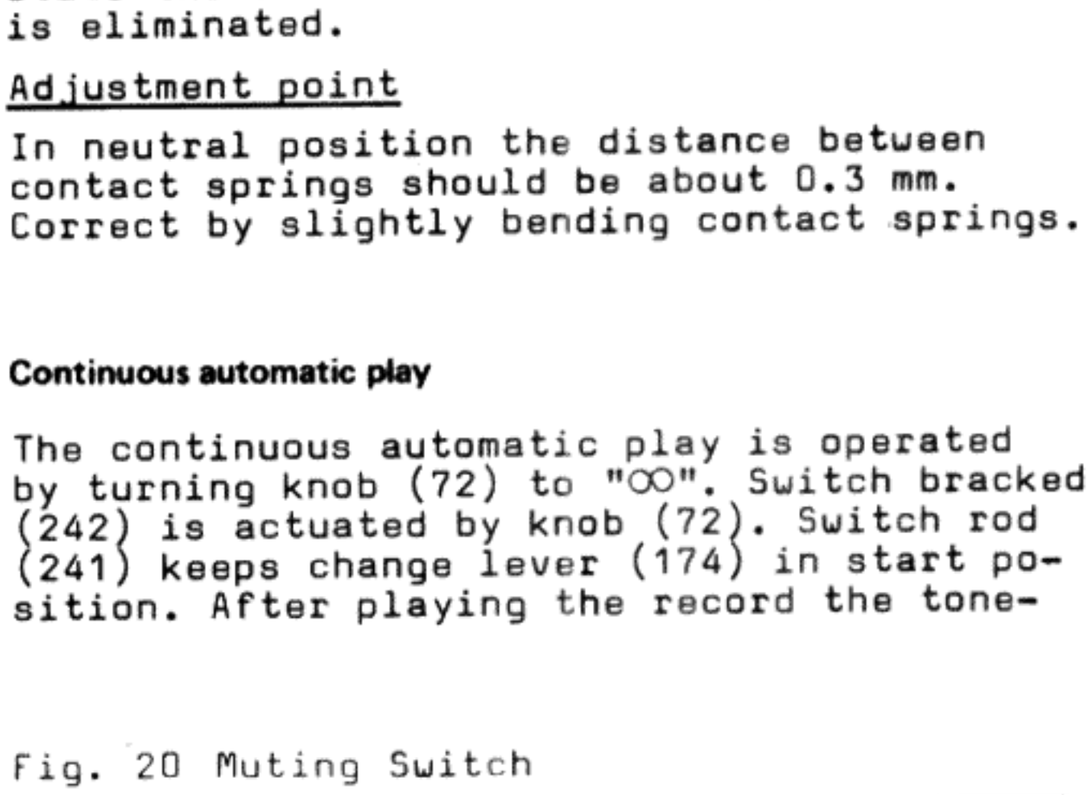
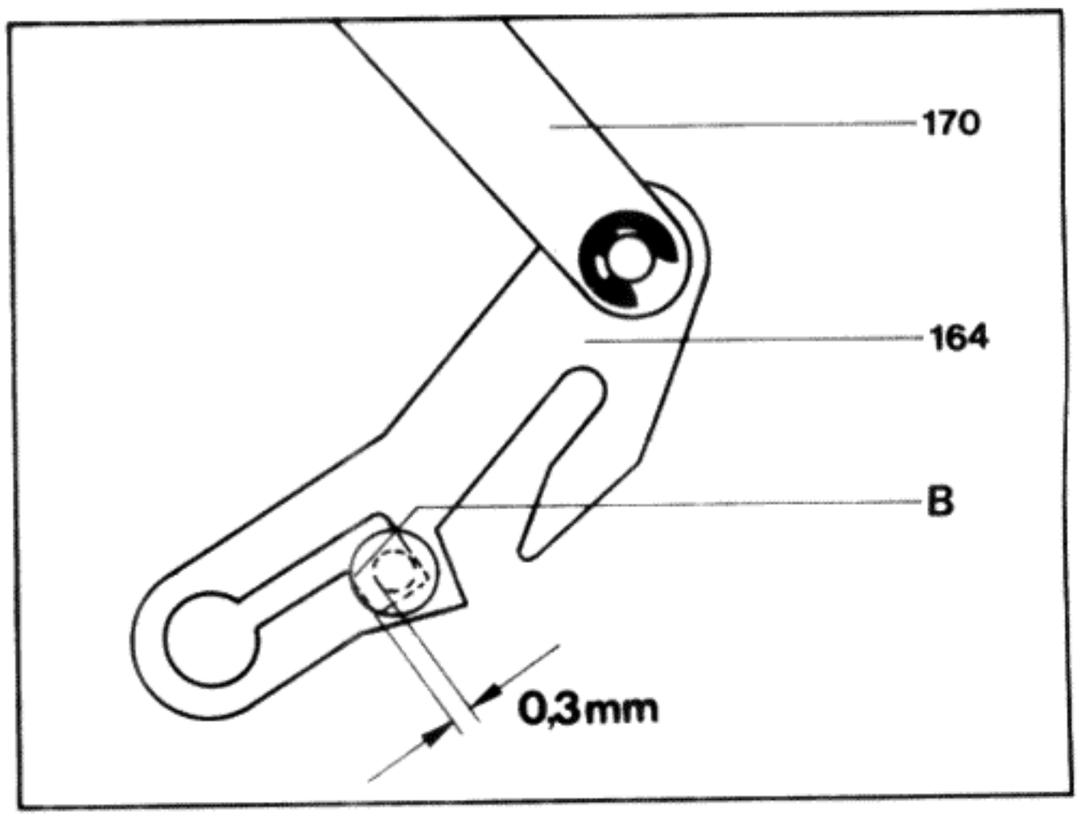


Fig. 21



Defect

Tonearm head not parallel to platter.

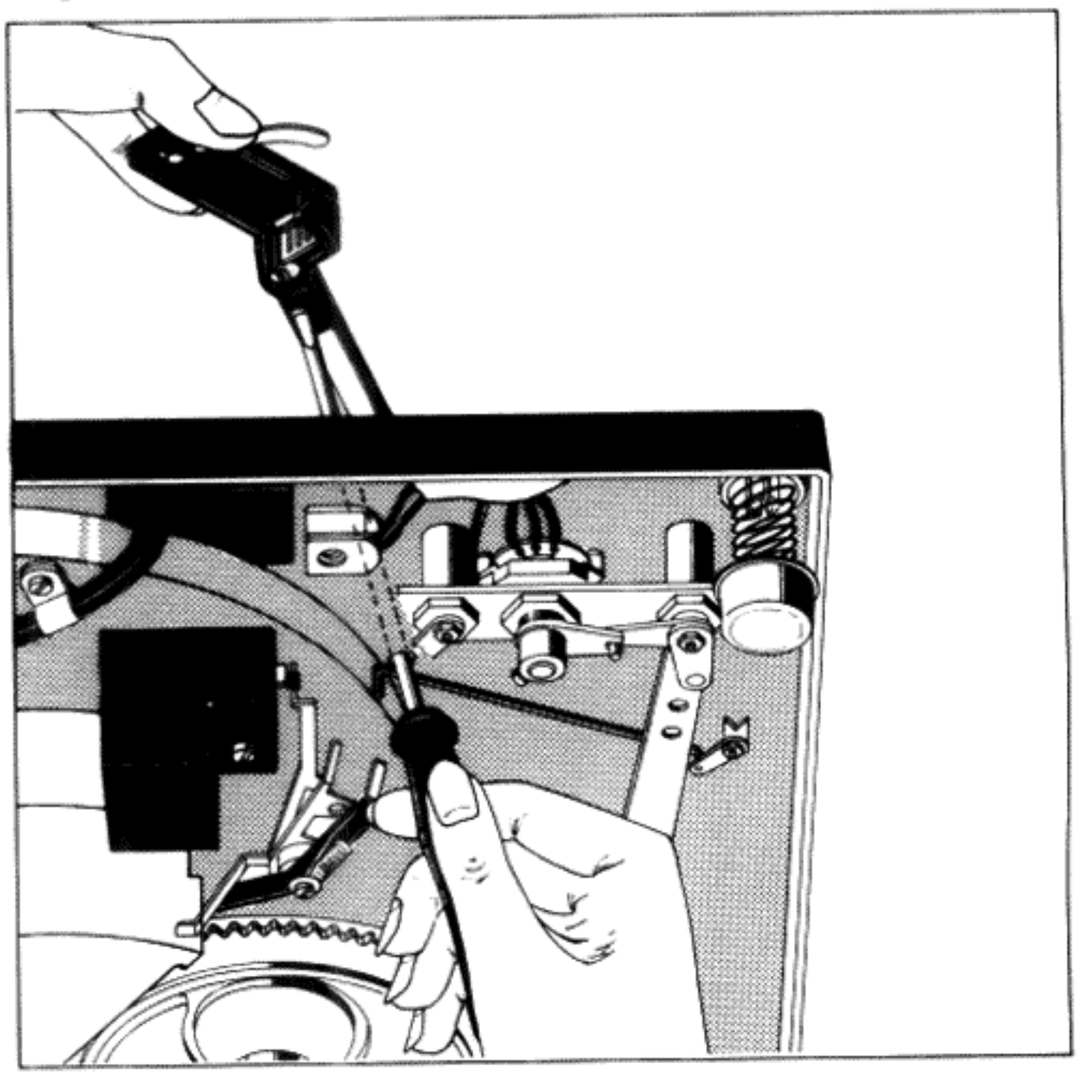
Cause

Seat of tonearm head on the tonearm tube has changed during transit.

Remedy

Remove platter. Insert screwdriver through the hole in the chassis mounting plate. Align tonearm head and retighten screw (Fig. 22).

Fig. 22



Shut-off Operation

The functions of automatic set-down and shut-off are determined by the position of the deflection lever (139). The deflection lever (139) is only moved out of stop position during starting by the change lever (174). Initiation of shut-off after playing the record is brought about by the dog (M) of the motor pinion and the shut-off lever (142).

The shut-off lever (142) is guided onto the dog by the movement of the tonearm when playing the record with the aid of the shut-off bar (182) proportionate to the groove lead. The eccentrically-mounted dog forces the shut-off lever (142) back with each revolution as long as the advance of the tonearm only amounts to the width of one groove (Fig. 24 a).

Only the run-out groove with its increased lead guides the shut-off lever (142) onto the dog at a higher rate so that the shut-off lever is picked up and moved along (Fig. 24 b). The camwheel (144) is thus moved out of zero position into engagement with the motor pinion (Fig. 18 c).

Adjustment point:

With the eccentric pully "S" on segment (230) the shut-off point can be varied.

Fig. 23 Shut-off Operation

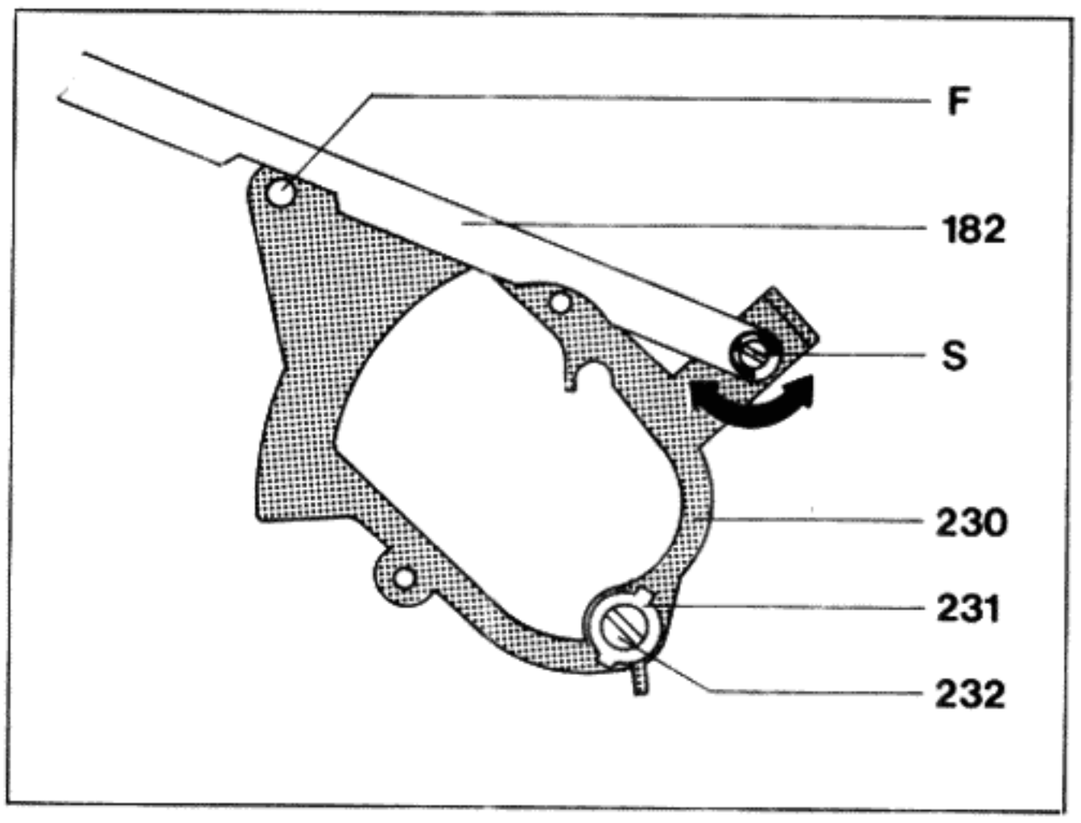
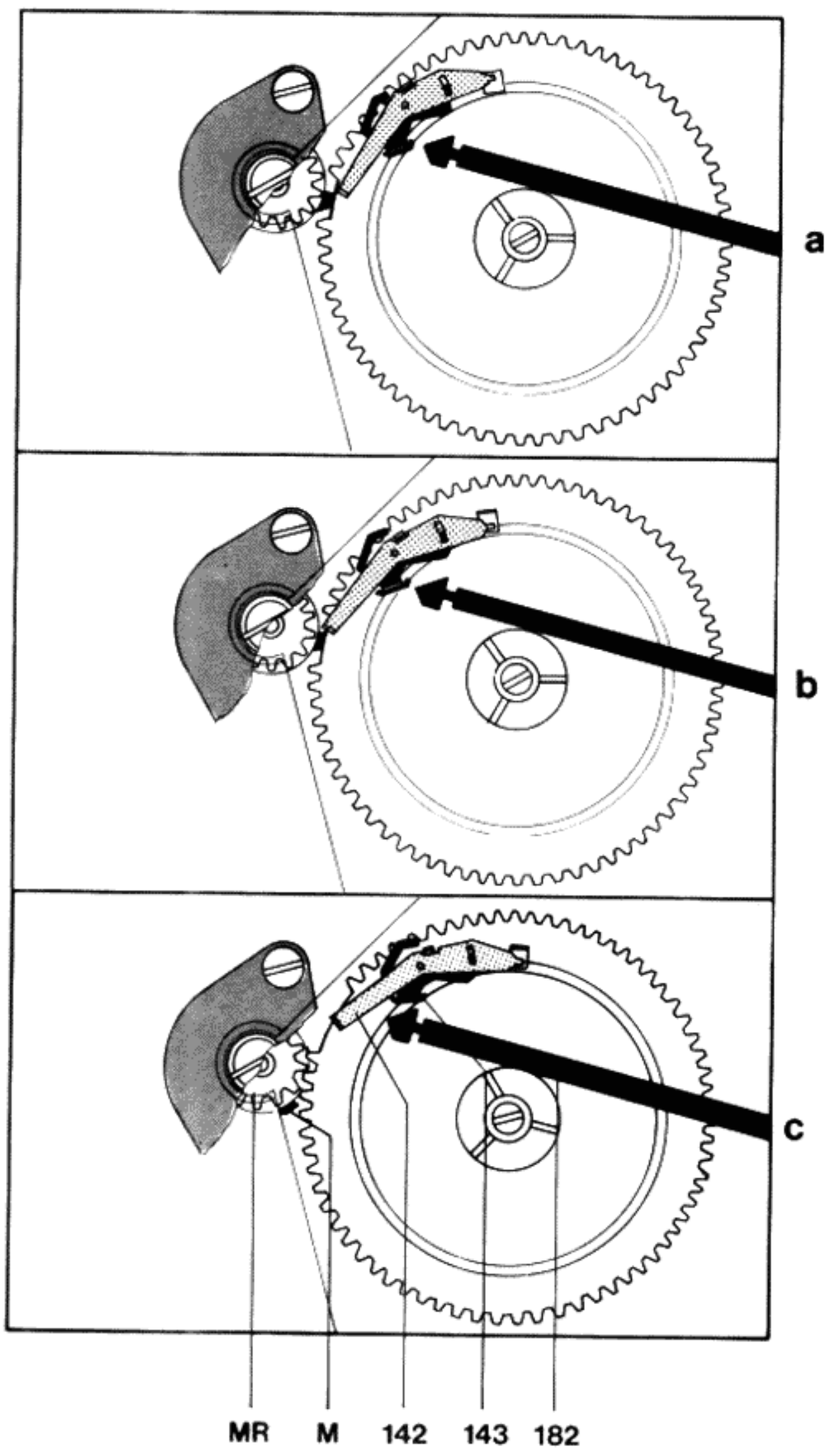


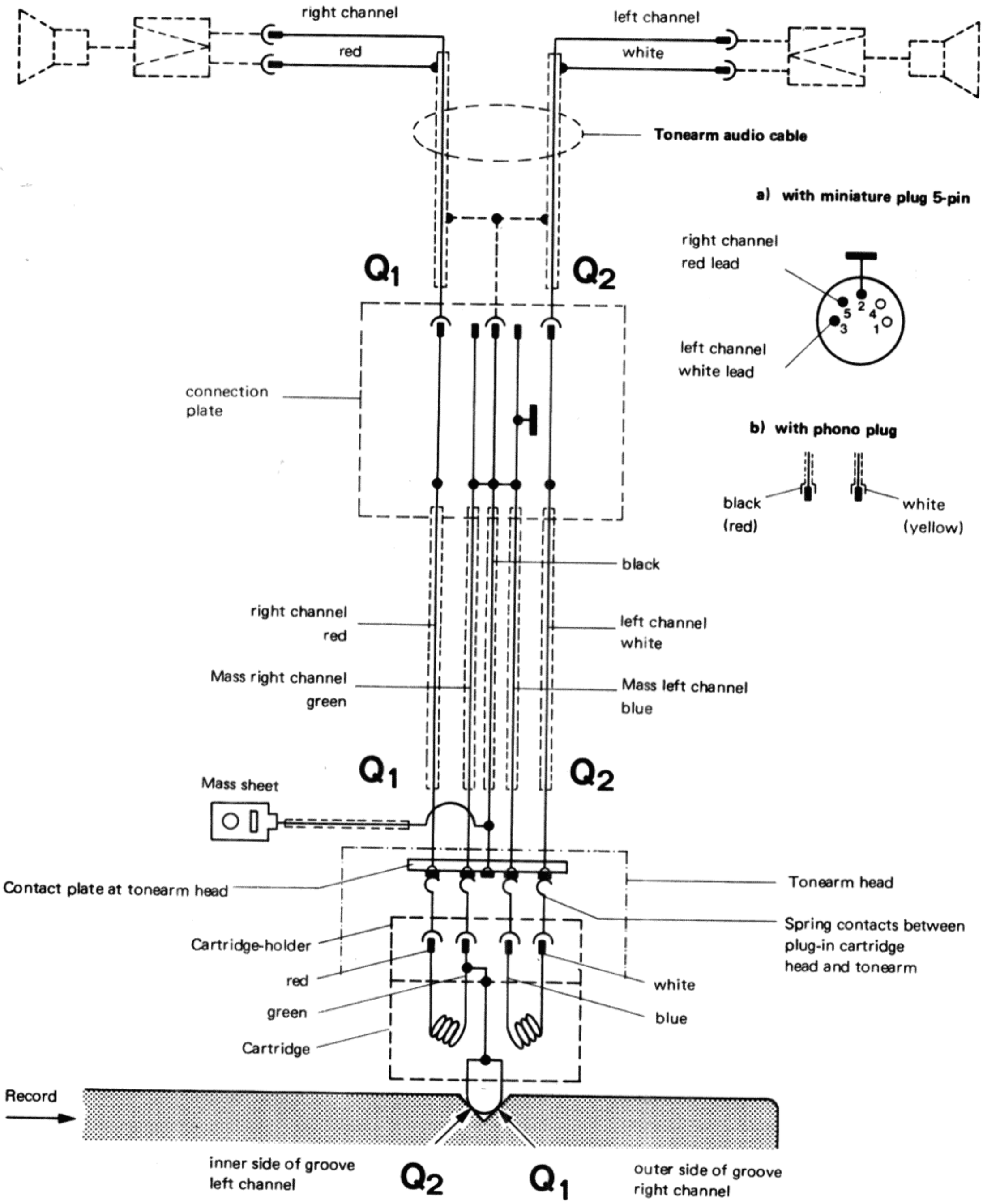
Fig. 24



Defect	Cause	Remedy
Stylus slips out of playing groove	a) Tonearm is not balanced	a) Balance tonearm
	b) Tonearm tracking force is too low	b) Adjust tracking force to the value stated by the cartridge manufacturer
	c) Anti-skating setting incorrect	c) Correct anti-skating setting
	d) Stylus tip worn or chipped	d) Renew stylus
	e) Excessive bearing friction in tonearm bearing	e) Check tonearm bearings and re-adjust if necessary
	f) Steel ball (136) of shut-off bar (182) missing	f) Renew steel ball (136).
	g) Friction of dog of segment (230) in guide piece (215). (Segment shifting when tonearm is in stop position for 30 cm records.)	g) Bend holding spring (231) or check adjustment points "b" (Fig. 18, page 15).

Defect	Cause	Remedy
Tonearm does not set down at the edge of the record	a) Record size setting incorrect b) Tonearm set-down point is incorrectly set.	a) Carry out necessary adjustment with the control lever (74). b) Set control lever (74) to "33". The adjustment screw becomes visible through the hole between the control lever (74) and the cue control. Turn adjustment screw either clockwise or anti-clockwise.
Tonearm does not set-down or sets-down too quickly after operating cue control lever (201)	a) Set screw (40) maladjusted. b) Damping excessive or too low by contamination of the silicone oil	a) Adjust set screw (40) for 3 - 5 mm cue control height. b) Using turning bush set for (>>>) or (>). If necessary, remove cue control plate (210), as described on page 14 and also remove shaft pin (204) on the lift pin (213), washer (205), adjustment sleeve, the second washer (205). Remove lift pin. Clean lift tube and lift pin. Smear lift pin evenly with "Wacker Silicone Oil AK 300 000". Reassemble components.
Vertical tonearm movement shows resistance during set-down	Excessive friction of lift pin (213) in guide tube	See above (b)
Tonearm returns to rest after manual set-down immediately after the platter starts to turn	Position of shut-off has altered during transport of the unit	After fitment and auch time after transport the unit should be started once with tonearm secured for automatic adjustment of automatic shut-off.
Tonearm moves with tracking force and anti-skating scale in 0 position a) outwards	a) Anti-skating device out of adjustment	a) Adjust skating lever (see p. 13/14)
b) inwards	b) Excessively tight tonearm leads produce a torque	b) Slacken tonearm leads
During automatic operation tonearm disturbing noises are perceptible	Muting switch out of adjustment. The distances between the slide springs and the short circuit strips on the muting switch are excessive.	By bending the short circuit strips. Adjustment is correct when, with the camwheel in neutral position, the distance between the slide springs and the short circuit strips on the muting switch is approx. 0.3 mm. Spray contact springs with preservative (e. g. Kontakt 61) and check adjustment of short circuit strips.
No reproduction. The short circuit of the pick-up leads is no longer being eliminated	Distance between the slide springs and the short circuit strips on the muting switch is absent or insufficient	By adjusting the short circuit strips. Adjustment is correct when, with the camwheel in neutral position, the distance between the slide springs and the short-circuit strips on the muting switch is approx. 0.3 mm.
Motor does not shut-off when tonearm sets down on rest	Suppression capacitor (111) in power switch is defective (short circuit)	Renew suppression capacitor in power switch (10.000 pF/700 V)
Acoustic feedback	a) Chassis components (e. g. also connecting leads) b) Connecting leads are too tight	a) Line up cutout in accordance with data in fitting instructions. Move leads. b) Slacken or lengthen cable

Fig. 25 Pick-up Connection Diagram



Replacement Parts

Pos.	Part. No.	Discreption	Qty.	
1	220 213	Centering disc	1	
2	238 434	Washer	1	
3	239 409	Turntable mat complete	1	
4	239 410	Turntable complete with mat	1	
5	239 411	Electronic direct drive system EDS 1000-2 compl.	1	
7	210 516	Machine screw M 4 x 8	3	
8	239 350	Washer 4.2/7/1	2	
9	237 644	Supporting post	2	
10	237 795	Dress plate	1	
11	210 586	Washer 3.2/7/0.5	6	
12	227 402	Flat head screw M 3 x 4	2	
13	237 668	Special screw	3	
14	239 413	Dual emblem	1	
15	200 444	Spring washer	2	
16	239 414	Shipping screw complete	3	
17	210 146	Lock washer 3.2	5	
18	201 632	Rubber washer	3	
19	237 117	Washer	3	
20	237 118	Lock washer	3	
21	239 415	Chassis complete	1	
22	234 432	Spring mount compl. (Tonearm side)	2	
	239 416	Spring mount compl. (Sapply unit side)	2	
23	230 529	Threaded piece	4	
24	232 842	Compression spring (Tonearm side)	2	
	238 556	Compression spring (Sapply unit side)	2	
25	200 723	Rubber damping block	4	
26	200 722	Steel cup	4	
27	239 417	Tonearm head compl.	1	
28	234 611	Handle	1	
29	210 182	Bowed lock washer	1	
30	210 630	Washer 4.2/8/0.5	2	
31	210 197	"C" clip G 4 x 8	1	
32	236 242	TK 24 cartridge mount	1	
33	236 896	Contact plate compl.	1	
34	237 671	Pointer	1	
35	237 672	Pin 2 x 6	1	
36	234 635	Lock nut	2	
37	230 063	Grub screw	1	
38	239 418	Frame compl.	1	
39	237 481	Tension spring	1	
40	237 623	Turning knob	1	
41	236 911	Tonearm rest compl.	1	
42	210 362	Hex nut BM 3	3	
43	218 321	Hex nut M 10	1	
44	237 530	Turning knob compl.	1	
45	237 661	Grub screw M 3 x 4	1	
46	239 419	Cover front compl.	1	
47	200 444	Spring washer	4	
48	234 635	Lock nut	1	
49	217 438	Grub screw	1	
50	239 188	Tonearm compl.	1	
51	239 420	Weight compl.	1	
52	236 160	Supporting plate	2	
53	239 421	Bearing rock	1	
54	236 051	Clamp bolt	1	
55	234 617	Fixing screw	2	
56	239 422	Bearing compl.	1	
57	210 475	Machine screw AM 3 x 5	1	
58	236 907	Spring housing compl.	1	
59	237 563	Washer	1	
60	237 564	Bearing screw	1	
61	237 471	Shaft	1	
62	237 581	Tension lever	1	
63	234 303	Compression spring	1	
64	237 577	Turning knob compl.	1	
65	210 361	Hex nut M 3	3	
66	237 618	Knurled ring	1	
67	216 867	Bowed lock washer 5.2/10	1	
68	225 176	Curve washer	1	
69	210 361	Hex nut M 3	3	
70	237 737	Fillister head screw countersunk M 3 x 10	2	
71	239 423	TA-Plate	1	
72	237 544	Turning knob compl.	1	
73	239 424	Cover complete	1	
74	237 537	Switch lever	2	
75	210 366	Hex nut BM 4	2	
76	237 738	Fillister head screw countersunk M 3 x 8	1	

Fig. 26 Exploded view, above chassis

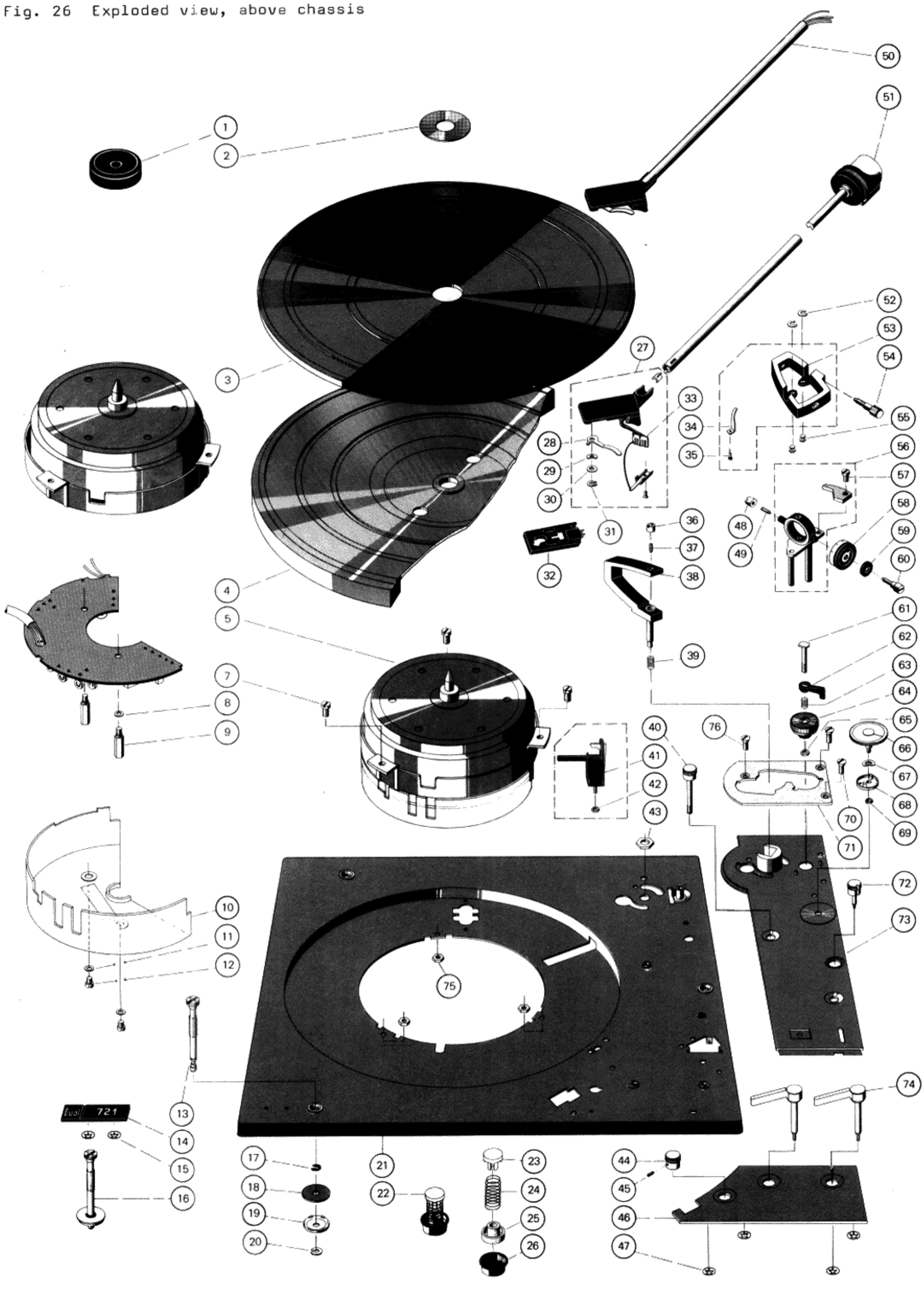
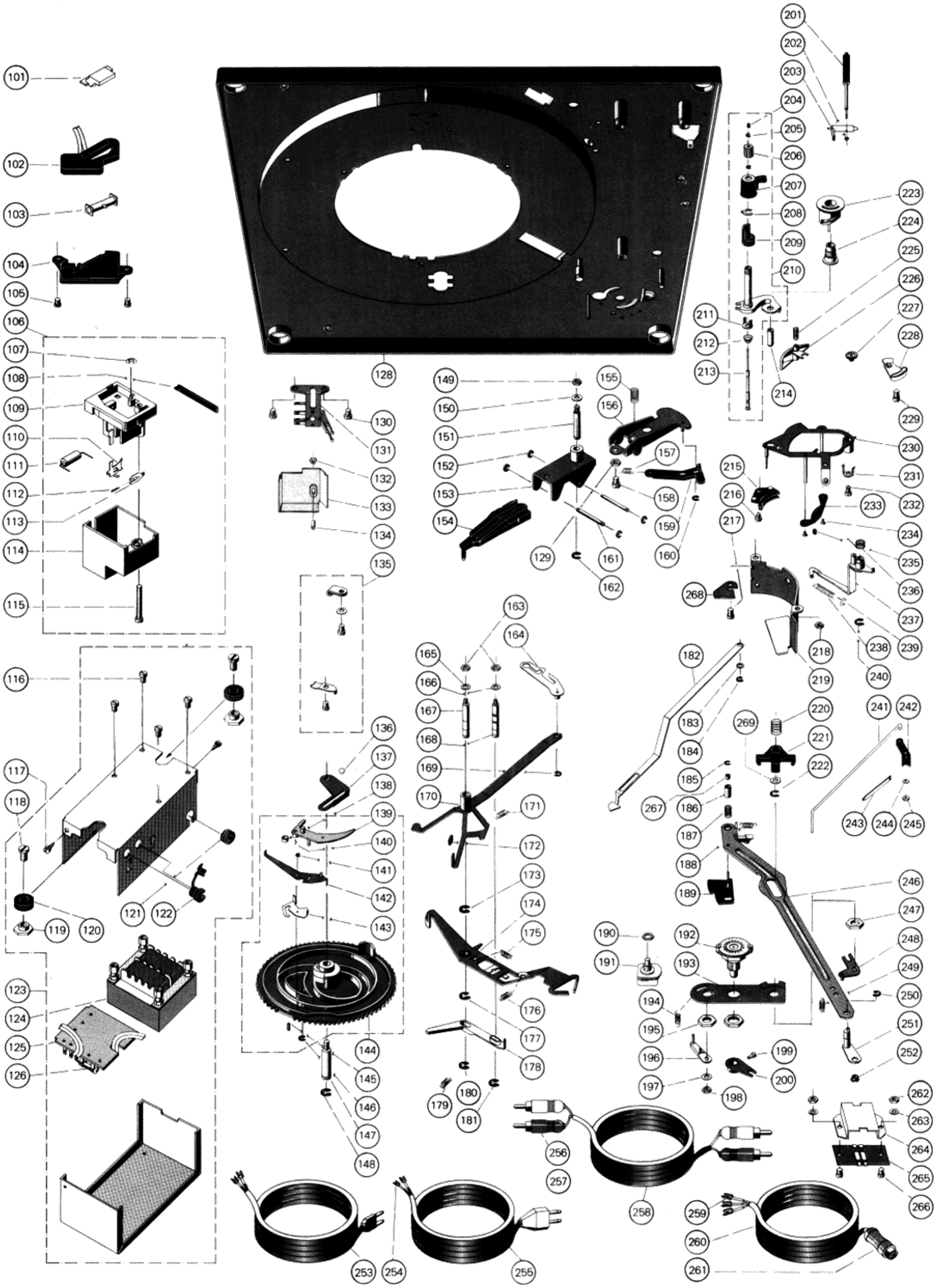


Fig. 27 Exploded view, below chassis



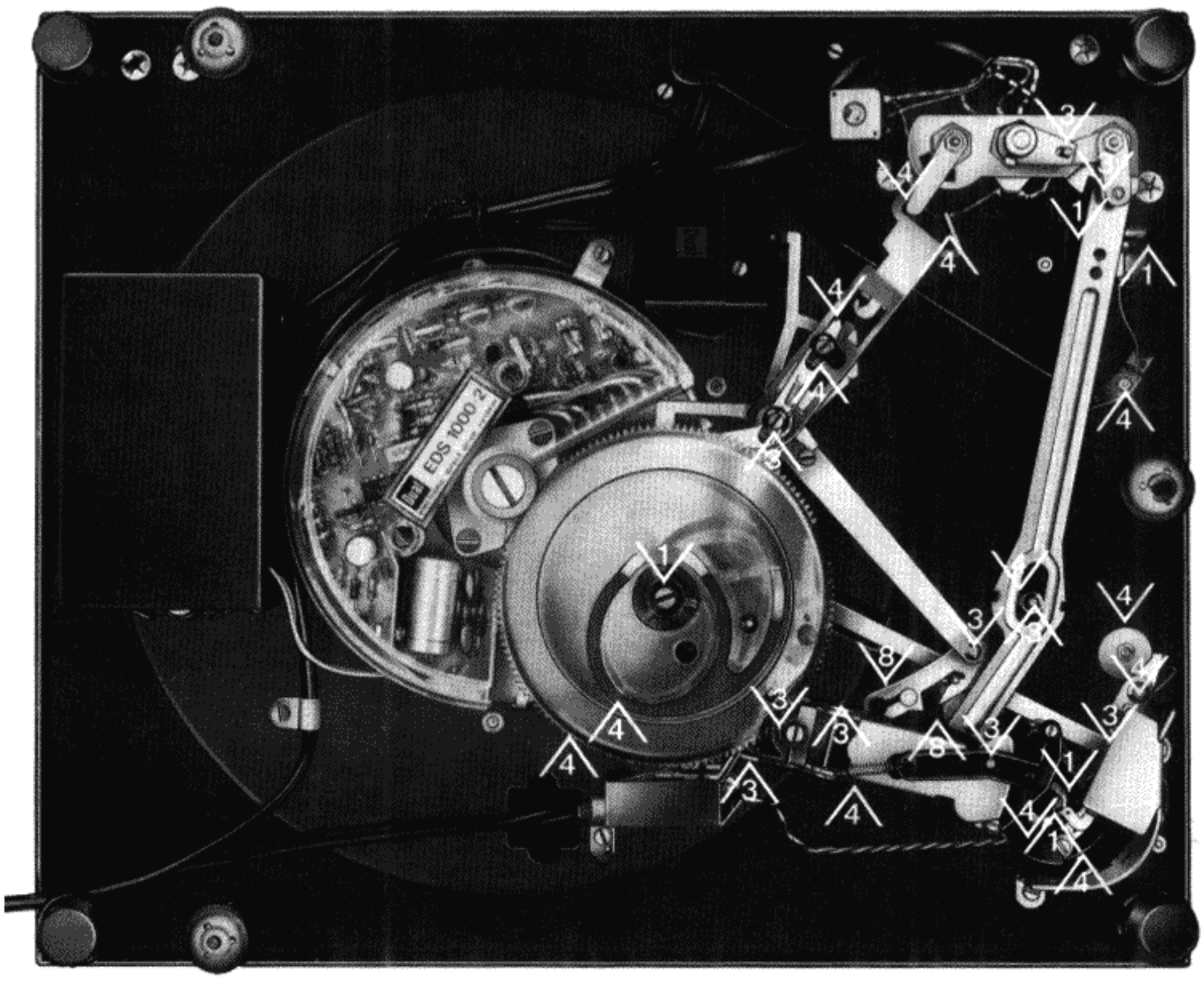
Pos.	Part. No.	Description	Qty.	
101	237 678	Deflecting prism	1	
102	237 677	Case, lower part	1	
103	225 321	Tublar glimm lamp	1	
104	237 679	Strobe cover	1	
105	210 472	Machine screw AM 3 x 4	2	
106	233 009	Power switch compl.	1	
107	200 444	Spring washer	1	
108	236 335	Slide	1	
109	233 012	Switch plate compl.	1	
110	230 148	Switch slide	1	
111	209 505	Capacitor 10 nF/1000 V/10 %	1	
112	230 296	Tension spring	1	
113	219 200	Snap spring	1	
114	233 010	Cover compl.	1	
115	210 498	Machine screw M 3 x 28	1	
116	210 480	Machine screw AM 3 x 6	4	
117	213 471	Machine screw self-tapping B 2.9 x 6.5	2	
118	210 516	Machine screw AM 4 x 8	2	
119	227 159	Joining nut M 4	2	
120	209 939	Sleeving	2	
121	209 934	Sleeving	1	
122	223 811	Sleeving with strain relief	2	
123	239 425	Supply unit compl.	1	
124	229 058	Power transformer compl.	1	
125	229 073	Power plate compl.	1	
126	209 719	Fuse 0.125 A/250 V	1	
C 51	225 322	Foil capacitor 68 nF/400 V/10 %	1	
C 52	224 886	Foil capacitor 47 nF/250 V/10 %	1	
D 51	225 247	Silicon diode BY 183/300	1	
R 51	225 916	Carbon resistor 22 kohms/0.25 W/5 %	1	
R 52	225 916	Carbon resistor 2.7 kohms/0.125 W/5 %	1	
128	239 415	Chassis complete	1	
129	210 361	Hex nut M 3	3	
130	210 472	Machine screw AM 3 x 4	2	
131	239 426	Muting Switch	1	
132	227 450	Hex nut M 2.6	1	
133	227 101	Shield	1	
134	227 100	Sleeve	1	
135	231 079	Cable holder compl.	1	
136	209 358	Ball 4.0	1	
137	237 511	Intermediate plate complete	1	
138	200 650	Rubber sleeve	2	
139	237 515	Cam follower lever	1	
140	200 522	Toggle spring	1	
141	210 142	Lock washer	1	
142	232 608	Shutt-off lever	1	
143	232 606	Friction plate	1	
144	239 427	Cam wheel complete	1	
145	234 026	Grub screw M 2.5 x 4.0	1	
146	210 145	Lock washer	8	
147	227 092	Bearing pillar	1	
148	210 148	Lock washer 5	1	
149	210 361	Hex nut M 3	3	
150	210 586	Washer 3.2/7/0.5	6	
151	227 078	Bearing bolt	1	
152	210 145	Lock washer 2.3	8	
153	227 080	Bearing support complete	1	
154	239 428	Control lever complete	1	
155	227 087	Compression spring	1	
156	237 507	Main lever	1	
157	237 555	Tension spring	1	
158	227 303	Special screw M 3 x 6	1	
159	237 510	Guide lever	1	
160	210 145	Lock washer 2.3	8	
161	216 864	Shaft	2	
162	210 146	Lock washer 3.2	5	
163	210 362	Hex nut BM 3	2	
164	237 519	Detent	1	
165	210 586	Washer 3.2/7/0.5	6	
166	210 586	Washer 3.2/7/0.5	6	
167	237 489	Grooved shaft	1	
168	237 490	Grooved bolt	1	
169	210 145	Lock washer 2.3	8	
170	237 491	Switch arm compl.	1	
171	237 665	Tension spring	1	
172	200 650	Rubber sleeve	2	

Pos.	Part. No.	Description	Qty.	
173	210 147	Lock washer 4	3	
174	237 493	Control lever assembly	1	
175	239 444	Tension spring	1	
176	200 103	Tension spring	1	
177	210 147	Lock washer 4	3	
178	237 497	Start lever	1	
179	227 045	Tension spring	1	
180	210 147	Lock washer 4	3	
181	210 147	Lock washer 4	3	
182	237 512	Shut-off bar	1	
183	201 187	Sliding washer	1	
184	210 145	Lock washer 2.3	8	
185	239 520	Lock washer	1	
186	237 663	Bush	1	
187	237 664	Compression spring	1	
188	227 072	Tension spring	1	
189	237 503	Stop compl.	1	
190	237 782	Potentiometer nut	1	
191	237 780	Fine speed control (R 33)	1	
192	237 781	Turning knob	1	
193	237 626	Bearing plate	1	
194	231 017	Tension spring	1	
195	237 536	Hex nut M 8 x 1	2	
196	237 378	Start lever	1	
197	210 586	Washer 3.2/7/0.5	6	
198	210 362	Hex nut BM 3	3	
199	210 472	Machine screw	1	
200	227 038	Switch member compl.	1	
201	237 541	Lever compl.	1	
202	210 353	Hex nut BM 2	1	
203	237 380	Lift cam	1	
204	237 660	Guide	1	
205	210 143	Lock washer 1.5	2	
206	218 318	Adjustment bush	1	
207	237 524	Turning bush	1	
208	237 461	Lock washer	1	
209	237 460	Adjustment cam	1	
210	239 429	Lift tube assembly	1	
211	237 459	Adjustment plate	1	
212	237 458	Compression spring	1	
213	237 457	Lift pin	1	
214	237 465	Pin	1	
215	237 474	Guide	1	
216	237 621	Machine screw AM 3 x 4	1	
217	237 621	Machine screw AM 3 x 4	1	
218	210 361	Hex nut BM 3	3	
219	237 488	Shield	1	
220	237 499	Compression spring	1	
221	237 498	Pivot bearing	1	
222	210 145	Lock washer 2.3	8	
223	237 451	Pivoting cam	1	
224	237 450	Bearing bush	1	
225	237 477	Compression spring	1	
226	237 476	Compensating cam	1	
227	237 480	Intermediate gear	1	
228	237 482	Adjustment plate	1	
229	210 480	Machine screw AM 3 x 6	1	
230	239 622	Segment cpl.	1	
231	237 475	Holding spring	1	
232	210 472	Machine screw AM 3 x 4	1	
233	239 623	Coupling plate assembly	1	
234	218 391	Countersunk screw	2	
235	237 479	Guide	1	
236	229 688	V-spring	1	
237	237 483	Skating lever	1	
238	218 591	Tension spring	1	
239	201 184	Adjusting washer	1	
240	210 146	Lock washer 3.2	5	
241	237 381	Linking lever	1	
242	237 382	Switch slide	1	
243	237 383	Leaf spring	1	
244	210 549	Washer 2.1/5/0.5	1	
245	210 353	Hex nut BM 2	1	
246	237 500	Adjustment rail	1	
247	237 536	Hex nut M 8 x 1	2	
248	237 376	Contact piece	1	
249	227 045	Tension spring	1	
250	210 146	Lock washer 3.2	5	

Pos.	Part. No.	Discreption	Qty.	
251	237 373	Adjustment plate	1	
252	237 379	Joining nut	1	
253	232 995	Power cable US compl.	1	
254	214 602	AMP connector	2	
255	232 996	Power cable Europe compl.	1	
256	209 426	Cynch plug black	2	
257	209 425	Cynch plug white	2	
258	226 817	Pick-up lead compl. with Cynch plug	1	
259	207 303	Pick-up lead compl.	1	
260	209 436	Flat connector sleeve	3	
261	209 424	Miniature plug	1	
262	210 362	Hex nut M 3	2	
263	210 155	Foothed washer 3.2	2	
264	233 089	Shield	1	
265	227 254	RCA-type socket plate	1	
266	210 480	Machine screw M 3 x 6	2	
267	200 650	Rubber sleeve	3	
268	239 481	Intermediate shim	1	
269	210 586	Washer 3.2/7/0.5	1	
****	214 120	Hardware for cartridge mounting	1	
****	238 422	Mounting instructions	1	
****	238 425	Operating instructions	1	
****	238 954	Operating instructions UAP	1	
****	229 321	Packing carton 721 complete	1	
****	239 624	Packing carton CS 721	1	

Alteration reserved!

Fig. 28



Lubricating Instructions

All bearing and friction points of the unit are adequately lubricated at the works. Replenishment of oil and grease is only necessary after aproximately 2 years of normal use of the record player as the most important bearing points (motor bearings) have sintered metal bushes.

Bearing points and friction faces should be lubricated sparingly rather than generously.

When using different lubricants, chemical decomposition can often take place. To prevent lubrication failure we recommend using the original lubricants stated below. The following lubricants should be used for subsequent lubrication:

1 Wacker Silicone Oil AK 300 000

3 BP Super Viscostatic 10 W/30

4 Shell Alvania No. 2

8 Molykote

Dual

Dual Gebrüder Steidinger · 7742 St. Georgen/Schwarzwald

920 334-2 5/0876

Printed in Germany by Dual